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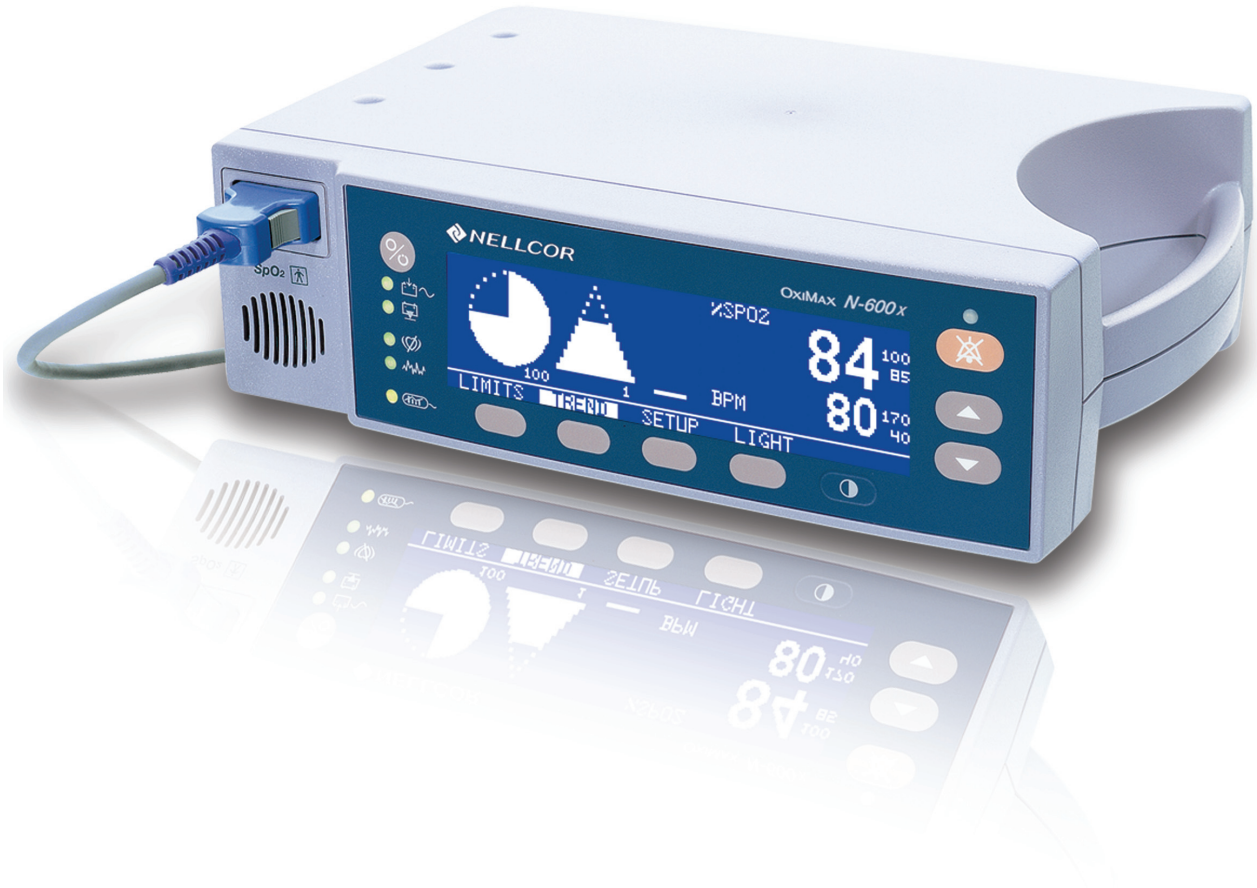
Operator's Manual

Nellcor™

N-600x Pulse Oximeter
Alarm Management System



Oximax™ Technology

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The OxiMax N-600x™ pulse oximeter is covered by one or more of the following U.S. patents and foreign equivalents: Patent No. 5,485,847; 5,676,141; 5,743,263; 6,035,223; 6,226,539; 6,411,833; 6,463,310; 6,591,123; 6,708,049; 7,016,715; 7,039,538; 7,120,479; 7,120,480; 7,142,142; 7,162,288; 7,190,985; 7,194,293; 7,209,774; 7,212,847.

To obtain information about a warranty, if any, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local representative.

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1 Safety Information

Overview

This section contains safety information requiring users to exercise appropriate caution while using the OxiMax N-600x™ pulse oximeter.

Warnings are identified by the WARNING symbol shown above.

Warnings alert you to potential serious outcomes (death, injury, or adverse events) to the patient or user.

Cautions are identified by the CAUTION symbol shown above.

Cautions alert the user to exercise care necessary for the safe and effective use of the OxiMax N-600x pulse oximeter.

Notes are identified by the NOTE symbol shown above. Notes are listed before or after procedural steps or information and provide additional guidelines or information on the subject being described.

Warnings

WARNING

The OxiMax pulse oximetry sensor extrapolates from the date and time provided by the Nellcor OxiMax N-600x pulse oximeter when recording the sensor event record to the sensor. The accuracy of the date/time is determined by the date/time setting of the pulse oximetry monitor. Set the pulse oximeter date and time to the correct value before connecting a record-enabled sensor to keep the date and time consistent for as long as the sensor remains connected. Since a sensor with sensor event record data can be transported from one oximeter to another, having discrepancies in the date/time

between oximeters and the sensor event record data will affect the order in which the sensor event record data appear. To eliminate this potential problem, set all oximeters within an institution to the same time.

WARNING

Explosion hazard—Do not use the OxiMax N-600x pulse oximeter in the presence of flammable anesthetics.

WARNING

Do not spray, pour, or spill any liquid on the pulse oximeter, its accessories, connectors, switches, or openings in the chassis, since this may cause damage to the oximeter.

WARNING

Supplemental oxygen will attenuate patterns of desaturation. A patient's respiratory compromise can be proportionally more severe before patterns appear in the saturation trend. Remain vigilant when monitoring a patient on supplemental oxygen.

WARNING

The LCD panel contains toxic chemicals. Do not touch broken LCD panels. Physical contact with a broken LCD panel can result in transmission or ingestion of toxic substances.

WARNING

Do not silence or decrease the volume of the OxiMax N-600x pulse oximeter's audible alarm if patient safety could be compromised.

WARNING

Failure to cover the OxiMax pulse oximetry sensor site with opaque material in high ambient light conditions may result in inaccurate measurements. Pulse oximetry readings and pulse signals can be affected by certain environmental conditions, OxiMax pulse oximetry sensor application errors, and certain patient conditions. See the appropriate sections of this manual for specific safety information.

WARNING

The use of accessories, sensors, and cables other than those specified may result in inaccurate readings of the OxiMax N-600x pulse oximeter and increased emission and/or decreased electromagnetic immunity of the oximeter .

WARNING

When installing the pulse oximeter's AC power cord, ensure the cord is carefully positioned to prevent tripping and entanglement.

Cautions

Caution

When connecting the OxiMax N-600x pulse oximeter to any instrument, verify proper operation before clinical use. Both the pulse oximeter and the instrument connected to it must utilize a grounded outlet. Accessory equipment connected to the pulse oximeter's data interface must be certified according to IEC Standard 60950 -1: 2005 for data-processing equipment or IEC Standard 60601-1:1988 + A1:1991 + A2:1995 for electromedical equipment. All combinations of equipment must be in compliance with IEC Standard 60601-1-1:2000 Requirements for Medical Electrical Systems. Anyone connecting additional equipment to the signal input port or signal output port (data port connector) is configuring a medical system and, therefore, is responsible for ensuring that the system complies with the Requirements for Medical Electrical Systems IEC Standard 60601-1-1:2000 and the electromagnetic compatibility IEC Standard 60601-1-2:2001 + A1:2004. Oximeter accuracy may degrade if it is connected to secondary I/O devices when the equipment is not connected to earth reference.

Caution

Federal law (U.S.A.) restricts this device to sale by or on the order of a physician.

Caution

Dispose of battery in accordance with local requirements and regulations.

2 General Introduction

Overview

WARNING

The OxiMax N-600x pulse oximeter is intended only as an adjunct in patient assessment. It must be used in conjunction with clinical signs and symptoms.

This manual contains information for operating the OxiMax N-600x™ pulse oximeter. Before operating the oximeter, thoroughly read the *N-600x Operator's Manual*. The latest version of this manual is available on the Internet at:

http://www.nellcor.com/serv/manuals.aspx

Oximeter Description and Intended Use

Description

The OxiMax N-600x pulse oximeter provides continuous noninvasive monitoring of functional oxygen saturation of arterial hemoglobin (SpO_2) and pulse rate. With the proper firmware, activation of the pulse oximeter's OxiMax SPD™ Alert (SPD) feature is possible.

Intended Use

The OxiMax N-600x pulse oximeter is intended for prescription use only with neonatal, pediatric, and adult patients who are well or poorly perfused in hospitals, hospital-type facilities, intra-hospital transport, and home environments. The OxiMax SPD™ Alert (SPD) feature is intended only for facility-use care of adults to detect patterns of desaturation indicative of repetitive reductions in airflow through the upper airway and into the lungs.

Note:

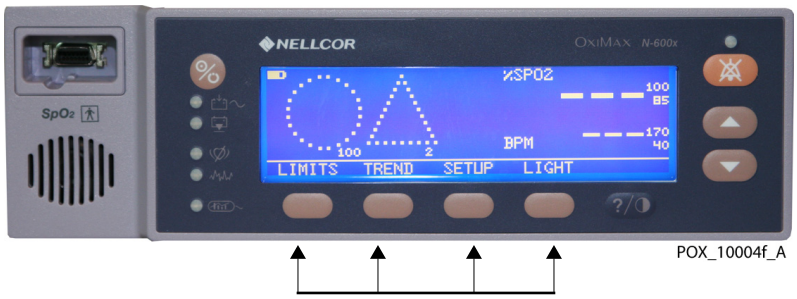
Intended typical usage may be defined to include the following for the OxiMax N-600x pulse oximeter:

- Hospital use typically covers such areas as general care floors (GCFs), operating rooms, special procedure areas, intensive and critical care areas within the hospital and in hospital-type facilities. Hospital-type facilities include physician office-based facilities, sleep labs, skilled nursing facilities, surgicenters, and sub-acute centers.
- Intra-hospital transport includes transport of a patient within the hospital or hospital-type facility.
- Homecare use involves a lay person (parent or other similar non-critical caregiver) in the home environment.

Use with any particular patient requires the selection of an appropriate OxiMax™ pulse oximetry sensor. Refer to *Using OxiMax™ Pulse Oximetry Sensors and Accessories*, page 93.

Through the use of the four softkeys, users can access trend information, change alarm limits, adjust the internal time clock, select the communications protocol, and choose the interface language native to the language of the facility, caregiver, or user. See *Using Oximeter Softkey Menus*, page 47.

Figure 1. Front Panel Menu Softkeys



The oximeter can operate on AC power or on an internal battery. The controls and indicators for the oximeter are illustrated and identified in *OxiMax N-600x Pulse Oximeter Front Panel,* Figure 2 on page 13 and *OxiMax N-600x Pulse Oximeter Rear Panel,* Figure 3 on page 18.

List of Components

The typical OxiMax N-600x pulse oximeter carton ships with the following packing list of contents.

Table 1. Typical Packing List

Quantity	Item
1	OxiMax N-600x pulse oximeter
1	Nellcor OxiMax pulse oximetry sensor or assortment pack
1	DOC-10 pulse oximetry cable
1	*N-600x Operator's Manual* (applicable to country of sale) and/or compact disc
1	Hospital-grade power cord (applicable to country of sale)
2	Fuses, 0.5 A, 250 volts, slow-blow, IEC (5 x 20 mm)
1	*N-600x Quick Guide*

Front Panel

Figure 2. OxiMax N-600x Pulse Oximeter Front Panel

Table 2. List of Front Panel Components

1	SpO2 Sensor Port	**14**	ADJUST UP & DOWN Keys
2	Low Battery Indicator	**15**	Pulse Rate (BPM) Upper Limit Value
3	AC Power Indicator	**16**	Pulse Rate (BPM) Lower Limit Value
4	ON/STANDBY Key	**17**	Neonate Mode Icon
5	Battery Fuel Gauge	**18**	HELP/CONTRAST Key
6	SatSeconds™ Icon & Limit Value	**19**	Fast Response Mode Icon
7	SPD Icon & Sensitivity Value	**20**	Pulse Rate (BPM)
8	Blip Bar	**21**	Menu Selection Softkeys
9	%SpO2 Real-time Value	**22**	Menu Bar
10	%SpO2 Upper Limit Value	**23**	Data In-Sensor Indicator
11	%SpO2 Lower Limit Value	**24**	Interference Indicator
12	Alarm Silence Indicator	**25**	Pulse Search Indicator
13	ALARM SILENCE Key	**26**	Oximeter Speaker

User Interface

Note:

Pressing a key, except the ON/STANDBY key, should result in either a valid or an invalid tone. If the key pressed fails to emit a tone, contact a qualified service technician.

ON/STANDBY Key—Use to turn the oximeter on and off.

ALARM SILENCE Key—Use to silence ANY current alarms for the alarm silence duration period. After silencing an alarm, press the key again to reactivate the alarm. Additionally, use it to view and adjust alarm silence duration and alarm volume. The ALARM SILENCE key clears "SENSOR OFF," "LOW BATTERY," and "SENSOR DISCONNECT"

messages from the display. It lights continuously when an audible alarm has been silenced. It flashes when the alarm silence duration has been set to OFF.

WARNING

Pressing ALARM SILENCE will keep ALL alarms from sounding for the alarm silence duration period.

WARNING

Should the caregiver silence an SPD alarm, this resets the index that tracks repetitive patterns of desaturation and silences ALL alarms.

Caution

Should the caregiver fail to clear a primary audible alarm within two (2) minutes, a secondary alarm with a unique pitch sounds.

ADJUST UP Key —Use to increase variable parameters of the oximeter.

ADJUST DOWN Key—Use to decrease variable parameters of the oximeter.

HELP/CONTRAST Key—Use to access the on-screen help or adjust the screen contrast.

- Press and release the HELP/CONTRAST key to launch on-screen help.
- Press and hold the HELP/CONTRAST key while simultaneously pressing the ADJUST UP and ADJUST DOWN keys to increase or decrease the contrast of the display screen.

Softkey Menu Bar—Use to display the current softkey menu functions.

Oximeter Visual Indicators

- **AC Power Indicator**—Lights continuously when connected to an AC power source and also shows when the battery is charging. Does not light when the oximeter is running on the internal battery.
- **Low Battery Indicator**— Lights continuously when 15 or fewer minutes of battery capacity remain, then flashes when the battery capacity reaches a critically low condition.
- **Pulse Search Indicator**—Lights continuously prior to initial acquisition of a pulse signal and during prolonged, challenging monitoring conditions. The pulse search indicator flashes during a loss-of-pulse signal.
- **Interference Indicator**—Lights whenever the oximeter algorithm detects the incoming signal quality is degraded. An intermittently lit Interference Indicator is common during patient monitoring, and indicates the oximeter algorithm is dynamically adjusting the amount of data required for measuring SpO_2 and Pulse Rate. When lit continuously, the oximeter algorithm has extended the amount of data required for measuring SpO_2 and Pulse Rate. In this case, fidelity in tracking rapid changes in these values may be reduced.

Note:

Degradation can be caused by ambient light, poor sensor placement, electrical noise, electro-surgical interference, patient activity, or other causes.

Data In-Sensor Indicator—Lights to indicate that the attached OxiMax pulse oximetry sensor contains a patient sensor event record. The sensor event record information may be viewed or printed.

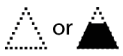
Battery Fuel Gauge—Displays the battery charge remaining on the oximeter. The battery fuel gauge consists of four bars, each corresponding to approximately 1.5 hours of operating time. All four bars are lit when the battery is fully charged. No bars are lit when a low battery condition exists. Visible in all display views. See *Battery Fuel Gauge*, page 33.

Plethysmographic (pleth) Waveform—This non-normalized waveform uses real-time sensor signals, reflecting relative pulsatile strength and quality of incoming signals. This indicator is only available in the pleth display view.

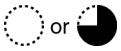
Pulse Amplitude (blip bar)—Indicates pulse beat and the relative (non-normalized) pulse amplitude. As the detected pulse becomes stronger, more bars light with each pulse. This indicator is only available in the blip and general care format (GCF) display views.

%SpO2 Value—Indicates hemoglobin oxygen saturation levels. The display value flashes zeros during loss-of-pulse alarms and flashes the %SpO_2 value when the SpO_2 is outside the alarm limits. The oximeter continues to update the display during Pulse Search. Current upper and lower alarm limit settings appear as smaller values to the right of the dynamic %SpO_2 value. Visible in all display views.

Pulse Rate Value—Displays the pulse rate in beats per minute. It flashes during loss-of-pulse alarms and when the pulse rate is outside of the alarm limits. During Pulse Search, the oximeter continues to update the display. Pulse rates outside of the pulse rate range of 20 to 250 bpm are displayed as 0 and 250, respectively. Current upper and lower alarm limit settings appear as smaller values to the right of the dynamic pulse rate value. Visible in all display views.



Saturation Pattern Detection (SPD) Icon—The OxiMax SPD™ Alert (SPD) feature detects patterns of desaturation in the SpO_2 trend in adults. When the SPD feature is enabled, the oximeter detects patterns of desaturation indicative of repetitive reductions in airflow through a patient's upper airway into the lungs. When the SPD feature detects patterns of desaturation in the SpO_2 trend in adults, caregivers are alerted to these patterns via a visual indicator, and optionally, an audio alarm. The triangle icon for SPD appears on the monitor display when the feature is enabled. The triangle fills from the bottom to the top as patterns become more severe. The triangle empties from top to bottom as the patterns become less severe. If the triangle fills, an alarm sounds. With SPD enabled, the default setting is On with the sensitivity set to 1. The feature can be turned off in the LIMITS menu. Caregivers can select from three alarm sensitivity settings: 1 (most sensitive), 2 (medium sensitivity) or 3 (least sensitive), with 1 resulting in more alarms and 3 resulting in fewer alarms. The rate at which the SPD icon fills depends on the SPD sensitivity setting. To explore activation, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. To use the feature, reference *Using the OxiMax SPD™ Alert Feature*, page 60.



SatSeconds Icon—The SatSeconds feature provides alarm management for mild or brief SpO_2 limit violations. When the SatSeconds feature is enabled, the SatSeconds circle icon fills in the clockwise direction as the SatSeconds alarm management system detects SpO_2 readings outside of the limit setting. The SatSeconds icon empties in counterclockwise direction when SpO_2 readings are within limits. When the SatSeconds icon reaches full, a medium priority alarm sounds. Visible in all display views. For more information about using the feature, reference *Using the SatSeconds™ Alarm Management Feature*, page 64.

Fast Response Mode Icon—Appears at bottom right of the menu bar when enabled. The oximeter algorithm responds to changes in the SpO_2 data at differing rates: two to four seconds in Fast Mode and five to seven seconds in Normal Mode when calculating $\%SpO_2$. The response mode setting does not affect the algorithm's calculation of pulse rate, nor does it influence the recording of trend data, which occurs at one-second intervals. The response mode, however, may impact the SPD alarm behavior. Visible in all display views when enabled. For more information about using the feature, reference *To set the response mode*, page 54.

Neonate Alarm Limits Icon—Appears at the bottom far right of the menu bar when enabled. Visible when the alarm limits are set to neonate limit values, but not when set to adult limit values. For more information about using the feature, reference *To set adult or neonatal modes*, page 58.

Monitoring Values

WARNING

Failure to cover the OxiMax pulse oximetry sensor site with opaque material in high ambient light conditions may result in inaccurate measurements.

The OxiMax N-600x pulse oximeter continuously assesses the quality of the pulse oximetry signal while monitoring patient SpO_2 and pulse rate. Oximeter front panel values reflect the data derived from monitoring.

The N-600x pulse oximeter algorithm automatically extends the amount of data required for measuring SpO_2 and pulse rate depending on the measurement conditions.

- **Normal conditions**—During normal measurement conditions the averaging time is six to seven seconds (approximately three seconds in Fast Mode).
- **Brief abnormal conditions**—During conditions such as those caused by low perfusion, interference (e.g., external interference like ambient light), or a combination of these, the oximeter automatically extends the amount of data required beyond seven seconds. If the resulting dynamic averaging time exceeds 20 seconds, the pulse search indicator is lit solid and $\%SpO_2$ and Pulse Rates update every second.
- **More severe conditions**—As these conditions extend, the required amount of data continues to increase. If the dynamic averaging time reaches 40 seconds, the pulse search indicator flashes to denote a loss-of-pulse condition and $\%SpO_2$ and pulse rate flash values of zero. This activates the audible alarm state.

Audible Indicators

Audible indicators include pitched tones and beeps. Caregivers may choose to silence alarms by pressing the ALARM SILENCE key.

WARNING

Pressing ALARM SILENCE will keep ALL alarms from sounding for the alarm silence duration period.

Caution

Should the caregiver fail to clear a primary audible alarm within two (2) minutes, a secondary alarm with a unique pitch sounds.

Table 3. Audible Indicator Functions

Function	Description
Alarm Silence Reminder	Three beeps sound approximately every three minutes with the alarm silence duration set to OFF and the alarm silence reminder function enabled.
Piezo Tone	A high-pitched piezo tone sounds if there is no user response to an audible alarm, or if the oximeter detects a failure of the primary speaker.
Pulse Beep	Single beep sounds for each detected pulse. The pitch of the pulse beep signal changes with a point-by-point rise or fall in the saturation level.
High Priority Alarm	High-pitched, fast-pulsing tone indicates loss-of-pulse. **Note: If a High Priority Alarm is not silenced within 30 seconds by pressing the ALARM SILENCE key, the oximeter increases the urgency level of the audible alarm signal by alternating a piezo tone with the primary alarm tone.**
Medium Priority Alarm	Medium-pitched, pulsing tone indicates an SpO_2 or pulse rate limit violation. **Note: If a Medium Priority Alarm is not silenced within two minutes by pressing the ALARM SILENCE key, the oximeter increases the urgency level of the audible alarm signal by alternating a piezo tone with the primary alarm tone.**
Low Priority Alarm	Low-pitched, slow-pulsing tone at 3.5 second intervals indicates an OxiMax pulse oximetry sensor disconnect, low battery, or oximeter failure. **Note: If a Low Priority Alarm is not silenced within two minutes by pressing the ALARM SILENCE key, the oximeter increases the urgency level of the audible alarm signal by alternating a piezo tone with the primary alarm tone.**
SPD Alarm	A trio of quick high-, medium-, high-pitched tones at 2.5 second intervals.
High SpO_2Alarm	A pair of quick medium-pitched tones followed by a high-pitched pulsing tone at 2.5 second intervals.
Power-On Self-Test Pass	One-second tone indicates the oximeter has been turned on and has successfully completed the power-on self-test.
Confirmation Tone	Three beeps sound to confirm default settings are either saved or reset to factory defaults, or the trend data has been deleted.
Invalid Softkey Press	Quick, low-pitched tone indicates a softkey has been pressed that is inappropriate for the current state of the oximeter.
Valid Softkey Press	Quick, medium-pitched tone indicates appropriate softkey has been pressed.
Volume Setting Tone	Continuous tone indicates alarm volume adjustment.

Rear Panel

Figure 3. OxiMax N-600x Pulse Oximeter Rear Panel

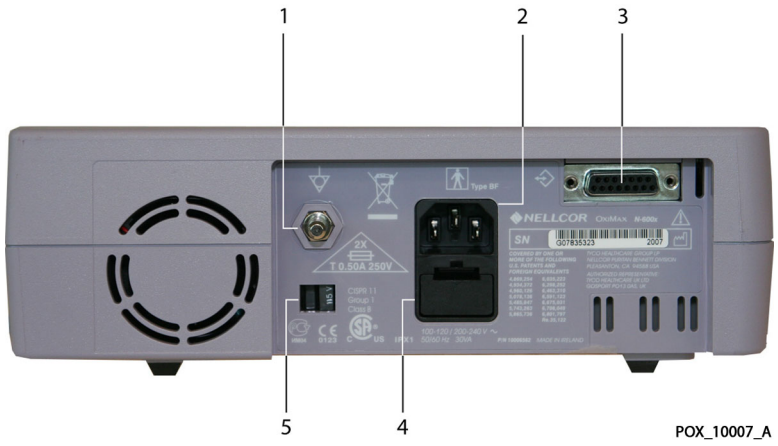


Table 4. Rear Panel Components

1	Equipotential Terminal (Ground)
2	AC Power Connector
3	Data Port Connector
4	Fuse Holder
5	Supply Voltage Selector Switch

Rear Panel Symbols and Descriptions

Warning! See Instructions for Use

Fuse replacement

Equipotential terminal (ground)

Date of manufacture

Data interface

Proper WEEE Waste Disposal

Type BF applied part - Not defibrillator proof

Oximeter Features

OxiMax SPD™ Alert Feature

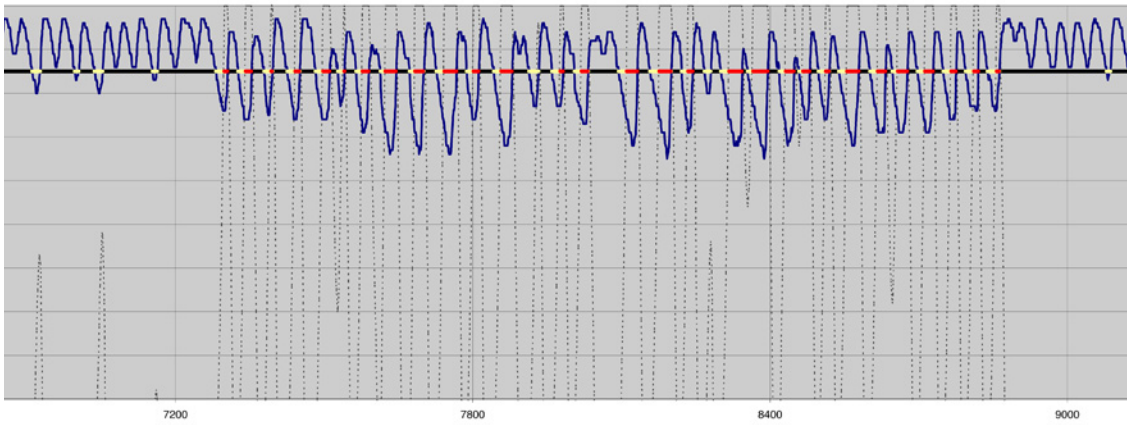
The OxiMax SPD™ Alert (SPD) feature detects patterns of desaturation in adults that are indicative of repetitive reductions in airflow through a patient's upper airway into the lungs. Relative reductions in a patient's minute ventilation over a period of time may cause a progressive drop in alveolar partial pressure of oxygen, leading to arterial desaturation. If these decreases in ventilation are repetitive, they generate distinct patterns in the saturation trend. Patterns of repetitive desaturation often develop gradually over time, increasing in severity. Detection of patterns indicates that a patient might be suffering progressively severe decrements in airflow that may increase in acuity if left untreated.

Patterns of desaturation are multiple, sequential occurrences of a desaturation followed by a resaturation. The SPD feature qualifies patterns of desaturation resulting from such repetitive reductions in airflow based on specific characteristics.

- The severity of the desaturation event (the depth of the desaturation during the event) and the extent of the following resaturation
- The regularity of the desaturation events (how often the pattern repeats)
- The slope of the desaturation/resaturation trends that form the events

The SPD feature qualifies these patterns of desaturation over a period of six (6) minutes. Depending on the sensitivity setting for SPD, patterns that persist may result in an SPD alarm, alerting the caregiver to the condition.

Figure 4. Clinically Significant Desaturation Patterns



Reference *Oximeter Display View Options*, page 23, *Managing the View Display*, page 39, *Using the OxiMax SPD™ Alert Feature*, page 60, and *OxiMax SPD™ Alert Feature*, page 124 for details.

SatSeconds™ Alarm Management Feature

The oximeter monitors the percentage of hemoglobin binding sites saturated with oxygen in the blood. With traditional alarm management, upper and lower alarm

limits are set to alarm at specific SpO2 levels. When the SpO2 level fluctuates near an alarm limit, the alarm sounds each time it violates the alarm threshold. SatSeconds monitors both degree and duration of desaturation as an index of desaturation severity. Thus, the SatSeconds feature helps distinguish clinically significant events from minor and brief desaturations that may result in nuisance alarms.

Figure 5. First SpO2 Event: No SatSeconds Alarm

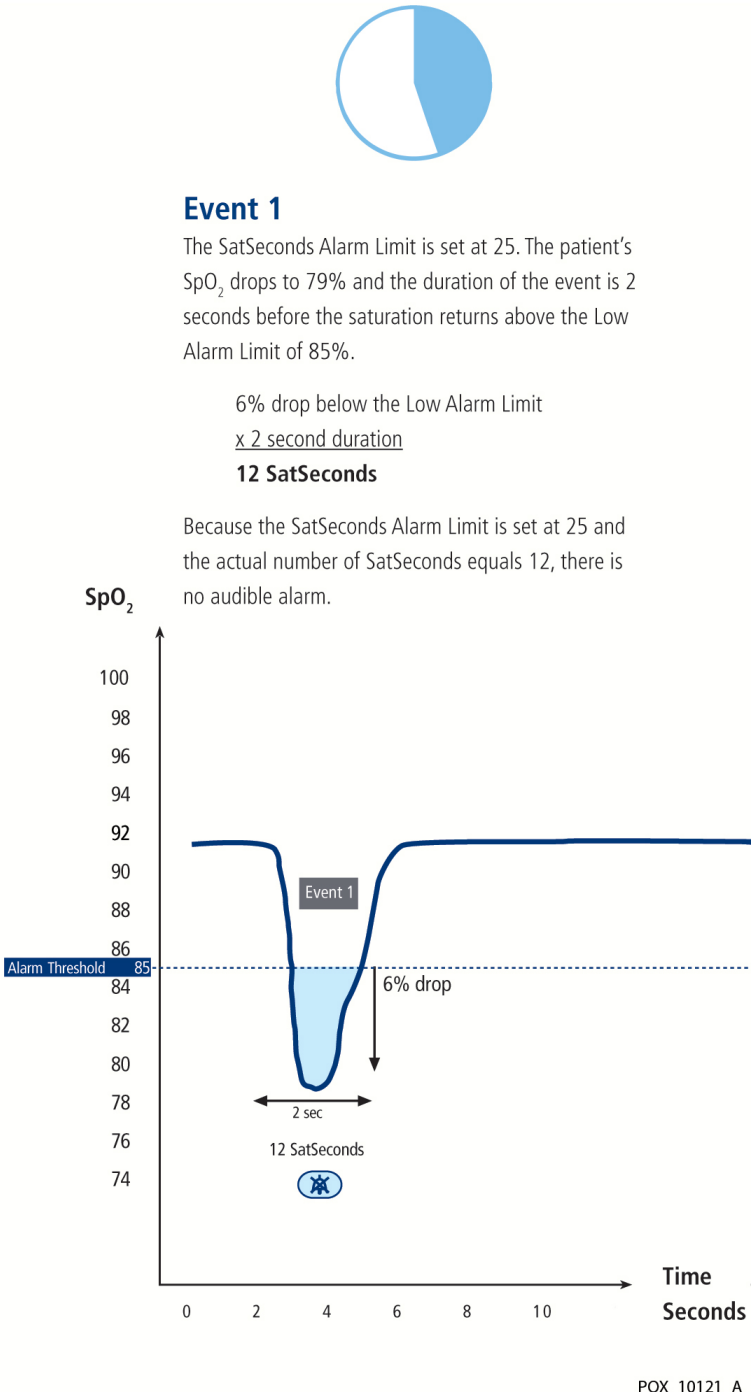


Figure 6. Second SpO2 Event: No SatSeconds Alarm

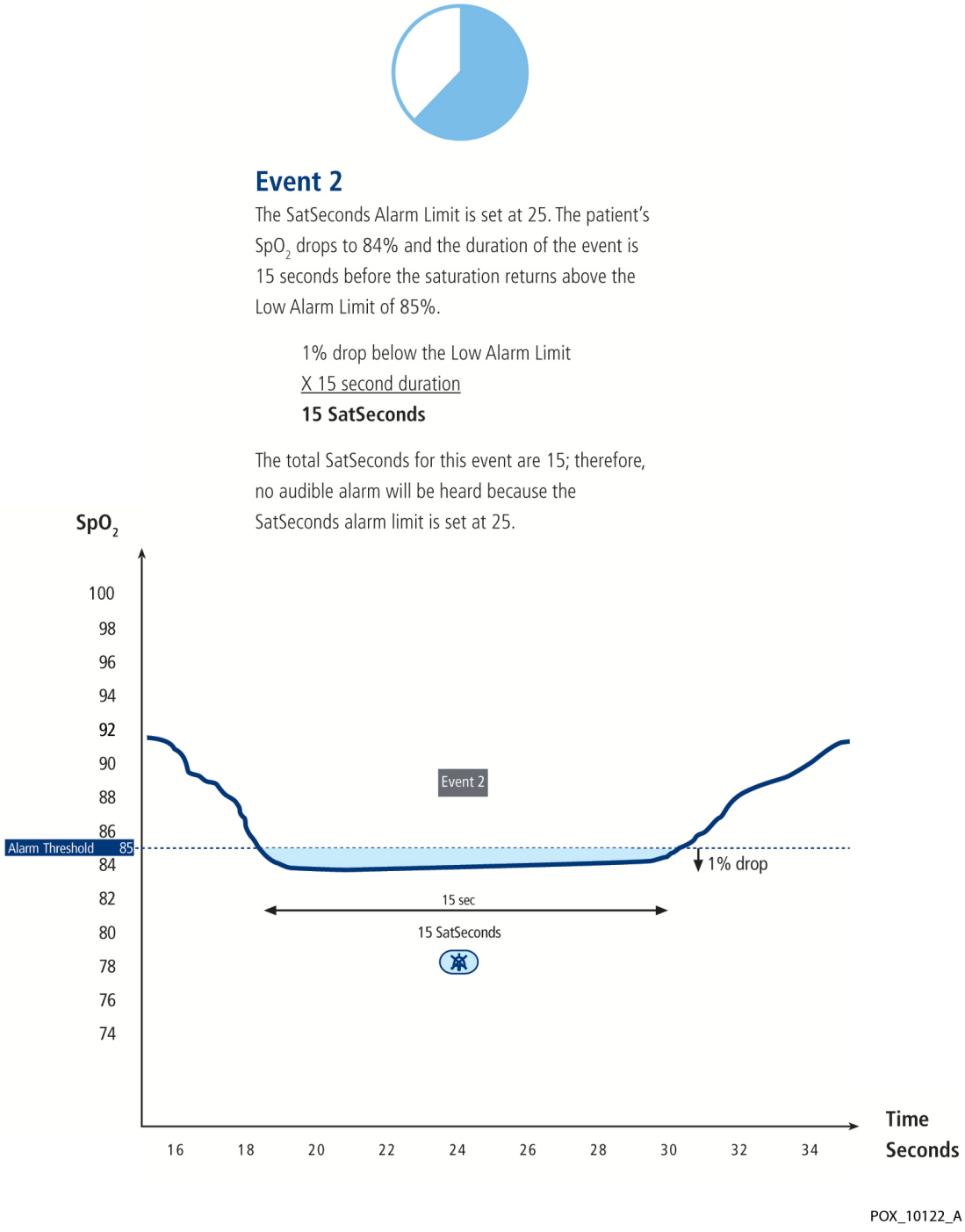
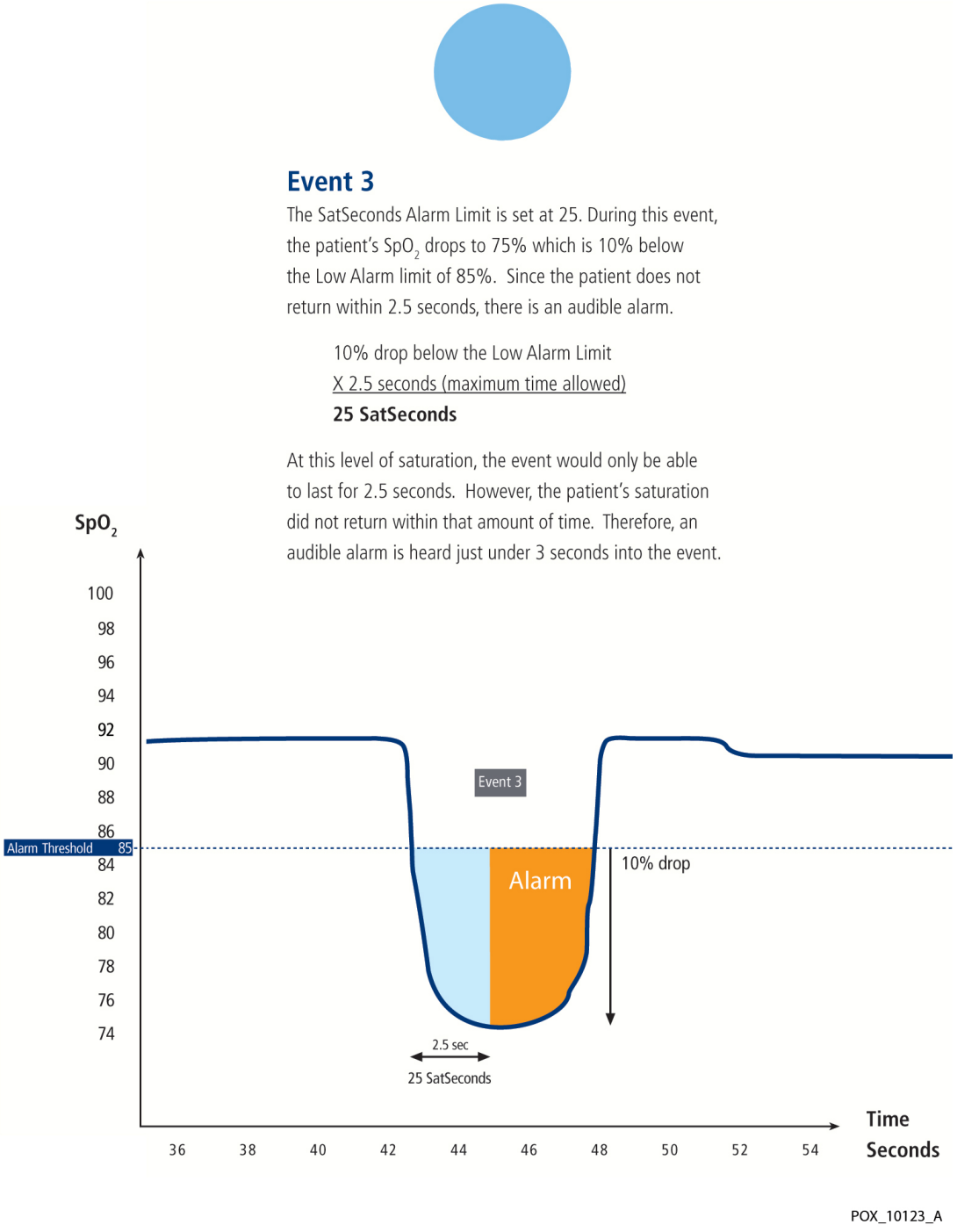


Figure 7. Third SpO2 Event: Triggers SatSeconds Alarm



The SatSeconds "Safety Net" is for patients with saturation levels frequently below the limit, but not staying below the limit long enough for the SatSeconds time setting to be reached. When three or more limit violations occur within 60 seconds, an alarm sounds even if the SatSeconds time setting has not been reached.

Reference *Oximeter Display View Options*, page 23, *Managing the View Display*, page 39, *Using the SatSeconds™ Alarm Management Feature*, page 64, and *SatSeconds™ Alarm Management Feature*, page 123 for details.

Pulse Rate Delay Alarm Management Feature

The oximeter monitors pulse rate by determining the number of pleth waves over unit time. With traditional alarm management, upper and lower alarm limits are set for monitoring pulse rate. When the pulse rate fluctuates near an alarm limit, the alarm sounds each time it violates an alarm limit. Use the Pulse Rate Delay feature to distinguish clinically significant events from minor and brief pulse rate limit violations that result in nuisance alarms. The Pulse Rate Delay feature allows a period of threshold violation before the pulse rate alarm sounds. Thus, the Pulse Rate Delay feature distinguishes clinically significant events from minor and brief pulse rate limit violations that may result in nuisance alarms.

To use the Pulse Rate Delay feature, set the traditional alarm management upper and lower pulse rate alarm limits. Then, set the Pulse Rate Delay. The Pulse Rate Delay limit controls the time the pulse rate level crosses either limit before an audible alarm sounds.

Reference *Oximeter Display View Options*, page 23, *Managing the View Display*, page 39, *Using the Pulse Rate Delay Alarm Management Feature*, page 63, and *Pulse Rate Delay Alarm Management Feature*, page 123 for details.

Oximeter Display View Options

Selecting Display Views

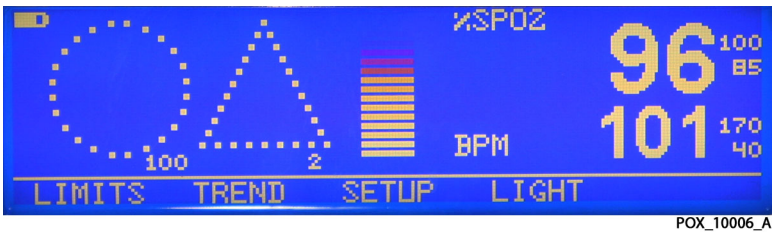
Select the display view for the OxiMax N-600x pulse oximeter that best suits the situation. The factory default setting is the General Care Format (GCF) display view.

Caution

Verify the movement of the blip bar, plethysmographic waveform, or flashing heart icon before accepting any oximeter data as a current measurement.

General Care Format (GCF) Display

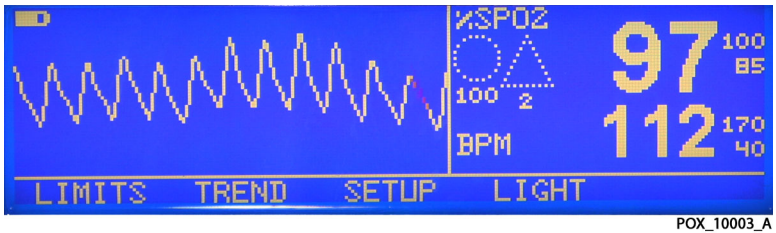
Figure 8. General Care Format Display View



Use this display view for large, easy-to-read monitoring information. The General Care Format (GCF) display includes the pulse amplitude blip bar, current measured SpO_2 and pulse rate, and current upper and lower SpO_2 and pulse rate limits. It also includes a battery fuel gauge if running on battery power. If enabled, SatSeconds and SPD icons display. For more information, reference *Managing the View Display*, page 39.

Plethysmographic (Pleth) Display

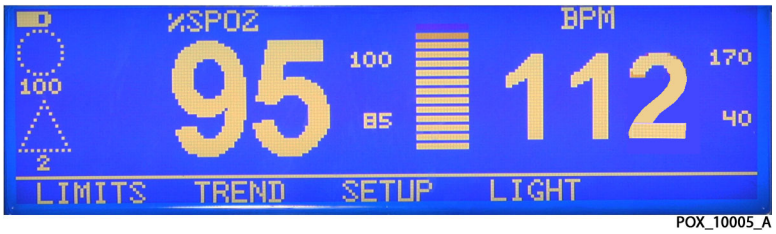
Figure 9. Pleth Display View



Use this display view for visual monitoring information in waveform. The plethysmographic (pleth) display includes a “wiper bar” plethysmographic waveform, menu bar, and current measured SpO_2 and pulse rate, upper and lower limit settings. It also includes a battery fuel gauge if running on battery power. Plethysmographic waveforms with peak to peak amplitudes less than ten pulse amplitude units (PAUs) are associated to one another. If enabled, SatSeconds and SPD icons display. For more information, reference *Managing the View Display*, page 39.

Blip Display

Figure 10. Blip Display View



Use this display view for visual monitoring information in blip bar form. The blip display includes a pulse amplitude blip bar, current measured SpO_2 and pulse rate, current upper and lower SpO_2 and pulse rate limits. It also includes a battery fuel gauge if running on battery power. If enabled, SatSeconds and SPD icons display. For more information, reference *Managing the View Display*, page 39.

Real-Time Trend Display

Figure 11. Real-time Trend Display View

Use this display view for visual monitoring information related to real-time trends. The trend data plots are automatically updated as the oximeter calculates each new trend point, where the interval between calculations is based on the display time

scale selected. The real-time trend display includes SpO_2 and/or pulse rate trend data plots, current measured SpO_2 and pulse rates. It also includes a battery fuel gauge if running on battery power. Each time the oximeter detects a pulse, the heart icon flashes. If enabled, SatSeconds and SPD icons display. For more information, reference *Managing the View Display*, page 39.

3 Setting Up the Oximeter

Safety Reminders

WARNING

To ensure patient safety, do not place the OxiMax N-600x pulse oximeter in any position where it might tip or fall on the patient.

WARNING

As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

WARNING

Ensure that the speaker is clear of any obstruction. Failure to do so could result in an inaudible alarm tone.

WARNING

Disconnect the oximeter and Nellcor OxiMax pulse oximetry sensor from the patient during magnetic resonance imaging (MRI) scanning. Objects containing metal can become dangerous projectiles when subjected to the strong magnetic fields created by MRI equipment. Also, induced currents could potentially cause burns.

WARNING

To ensure accurate performance and prevent device failure, do not subject the OxiMax N-600x pulse oximeter to extreme moisture, such as direct exposure to rain. Such exposure may cause inaccurate performance or device failure.

WARNING

Do not use any OxiMax N-600x pulse oximeter, OxiMax pulse oximetry sensor, cables, or connectors that appear damaged.

WARNING

Do not lift the pulse oximeter by the pulse oximetry cable or power cord. The cable or cord may disconnect, potentially dropping the pulse oximeter on a patient or a damaging surface.

WARNING

The OxiMax N-600x pulse oximeter is not defibrillator-proof. It may remain attached to the patient during defibrillation or during use of an electrosurgical unit, however readings may be inaccurate during the defibrillation and shortly thereafter.

WARNING

In the USA, do not connect the pulse oximeter to an electrical outlet controlled by a wall switch, since this increases the risk of removal of AC power to the pulse oximeter.

WARNING

Use only Nellcor-approved OxiMax pulse oximetry sensors and pulse oximetry cables when connecting to the OxiMax sensor connector. Connecting any other cable or sensor influences the accuracy of sensor data, which may lead to adverse results.

WARNING

Use only the Nellcor DOC-10 pulse oximetry cable with the OxiMax N-600x pulse oximeter. Use of another pulse oximetry cable will have an adverse effect on performance. Do not attach any cable that is intended for computer use to the SpO2 sensor port.

WARNING

The OxiMax N-600x pulse oximeter should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, observe the oximeter to verify normal operation in the desired configuration.

Note:

The OxiMax N-600x™ pulse oximeter incorporates watchdog timers which reset the oximeter in the event of software errors.

Connecting to an AC Power Source

WARNING

In the USA, do not connect the pulse oximeter to an electrical outlet controlled by a wall switch, since this increases the risk of removal of AC power to the pulse oximeter.

Caution

Set the Supply Voltage Selector switch to the correct voltage (115V or 230V) to avoid equipment damage and ensure proper battery charge.

Caution

Ensure the pulse oximeter is properly grounded when operating on AC power. If you are uncertain whether the AC outlet is properly grounded, disconnect the pulse oximeter from the outlet and use battery power. Contact a qualified electrician to examine the outlet for ground connections.

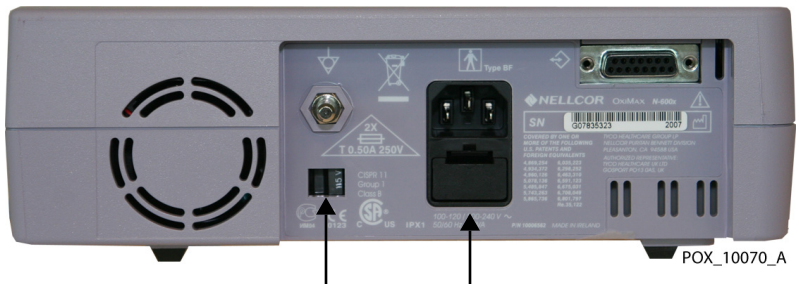
Caution

Use only the Nellcor hospital-grade power cord.

To connect to an AC power source

1. Set the Supply Voltage Selector switch to the applicable voltage.

Figure 12. Back Panel Supply Voltage Selector and Power Connector



2. Plug the female connector end of the power cord into the power connector on the rear of the oximeter.
3. Plug the male connector of the power cord into a properly grounded AC outlet.
4. Verify the oximeter's AC power indicator is lit.

Note:
If the AC power indicator is not lit, check the power cord, supply voltage selector switch, user-accessible fuses, and AC power outlet.

Using Battery Power

Power is supplied to the OxiMax N-600x pulse oximeter either from an AC connection (100-120 or 200-240 VAC) or from a 6-volt, 4 ampere-hour battery. The oximeter internal battery can be used to power the oximeter during transport or when AC power is not available. The transition between power sources is invisible to the user, from AC power to battery power or from battery power to AC power. A new, fully charged battery provides approximately seven hours of monitoring time under certain conditions.

- Pulse simulator set for 200 bpm, high light and low modulation
- No audible alarms sound
- No analog or serial output devices are attached to the oximeter, including serial data, analog output, and nurse call output
- Default display brightness setting

To fully charge the battery

Caution
To fully recharge a low or fully-depleted battery, connect the oximeter to an AC power outlet. Charge the battery for at least eight hours with the oximeter turned off or twelve hours with the oximeter turned on. Replace the battery if fewer than four bars are lit after fully charging the battery. Recharge the battery at least every three months, allowing the full charge time if it is the first recharge in several weeks.

1. Connect the oximeter to an AC power source. The oximeter will not power up without connection to AC power.

-

2. Verify the oximeter is off and the AC Power/Battery Charging indicator is lit. On AC power up, the battery fuel gauge shows empty. The oximeter operates on AC power while the battery is charging. When the oximeter is fully charged, all four bars are lit on the indicator.
3. Until the battery is recharged, the message, "UNIT WILL SHUT DOWN IF AC POWER IS LOST" appears. Press the ALARM SILENCE key twice to remove the message from the screen before the oximeter can be used for patient monitoring. The oximeter is now operational.

Caution

Should a low battery alarm sound, connect the oximeter to an AC power source and then clear the alarm by pressing the ALARM SILENCE key. If the oximeter is operated on an AC power source with a depleted battery and AC power is subsequently lost, the oximeter will shut down immediately.

When all of the following conditions are present for 15 minutes, the N-600x pulse oximeter automatically shuts down.

- The oximeter is running on battery power.
- No keys have been pressed.
- No pulse has been detected. If a patient is not connected to the OxiMax™ pulse oximetry sensor or the sensor is disconnected from the oximeter, the oximeter cannot detect data.
- No alarms are present, other than low battery or a non-correctable error.

Note:

Whenever the oximeter is connected to AC power source, the battery is being charged. Nellcor recommends the oximeter remain connected to an AC power source when not in use. This ensures full battery power when the oximeter is needed.

Connecting an OxiMax™ Pulse Oximetry Sensor

WARNING

Use only Nellcor-approved OxiMax pulse oximetry sensors and pulse oximetry cables when connecting to the OxiMax sensor connector. Connecting any other cable or sensor influences the accuracy of sensor data, which may lead to adverse results.

The bottom of the oximeter screen displays the OxiMax pulse oximetry sensor type when connecting an OxiMax pulse oximetry sensor to the oximeter or when the oximeter completes POST with an OxiMax pulse oximetry sensor attached.

Note:

Physiological conditions, medical procedures, or external agents that may interfere with the oximeter's ability to detect and display measurements include dysfunctional hemoglobin, arterial dyes, low perfusion, dark pigment, and externally applied coloring agents, such as nail polish, dye, or pigmented cream.

Note:

Sensor LED light emissions fall within Class 1 level, according to IEC 60825-1:2001.

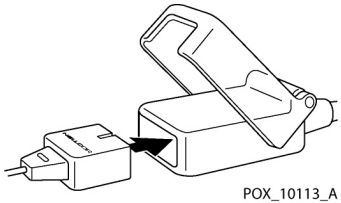
1. Firmly connect a DOC-10 pulse oximetry cable to the oximeter's SpO2 Sensor Port.

Figure 13. Front Panel Sensor Port Connector

POX_10004f_A

2. Open the plastic latch at the other end of the DOC-10 pulse oximetry cable.

Figure 14. Insertion of Cable into Plastic Latch on DOC-10 Pulse Oximetry Cable



POX_10113_A

3. Plug the cable and a Nellcor OxiMax SpO2 sensor together.
4. Snap the plastic latch down over the connectors.
5. When the oximeter detects a valid pulse, it enters the monitoring mode and displays real-time patient data.
6. Apply the sensor to the patient. Be sure to read the *Directions for Use* accompanying the sensor.

Reducing EMI (Electromagnetic Interference)

This device has been tested and found to comply with the limits for medical devices related to IEC 60601-1: 1988 + A1: 1991 + A2: 1995, EN60601-1:1990 + A11: 1993 + A12: 1993 + A13: 1996, and the Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

Because of the proliferation of radio frequency transmitting equipment and other sources of electrical noise in health care environments (for example, electrosurgical units, cellular phones, mobile two-way radios, electrical appliances, and high-definition television), it is possible that high levels of such interference due to close proximity or strength of a source may result in disruption of N-600x pulse oximeter performance.

The OxiMax N-600x pulse oximeter is designed for use in environments in which the pulse can be obscured by electromagnetic interference. During such interference, measurements may seem inappropriate or the oximeter may not seem to operate correctly. Disruption may be evidenced by erratic readings, cessation of operation, or

other incorrect functioning. If this occurs, survey the site of use to determine the source of this disruption, and take the listed actions to eliminate the source.

1. Turn equipment in the vicinity off and on to isolate the offending equipment.
2. Reorient or relocate the interfering equipment.
3. Increase the separation between the interfering equipment and the oximeter.

The oximeter generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference with other susceptible devices in the vicinity.

4 Operating the Oximeter

Overview

WARNING

Dispose of internal battery in accordance with local requirements and regulations.

This section identifies methods for viewing and collecting patient oxygen saturation data using the OxiMax N-600x™ pulse oximeter. It describes menu navigation, power on/off and display options, parameter ranges, OxiMax™ pulse oximetry sensor attachments, and configuring default settings suitable for the specific care environment.

Schedule regular maintenance and safety checks with a qualified service technician every 24 months. In the case of mechanical or functional damage, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative.

Monitoring Oximeter Power

Battery Fuel Gauge

Any time the oximeter is not connected to an AC power source, the oximeter runs on an internal battery. A battery fuel gauge indicator displays the remaining battery power. For more information, reference *Connecting to an AC Power Source*, page 28 and *Using Battery Power*, page 29.

If the battery is fully depleted, and the AC power is lost, the oximeter will shut down.

Table 5. Battery Fuel Gauge Levels

Level	Description
	Indicates 89-100% (approx. 6-7 hours) battery capacity remains.
	Indicates 64-88% (approx. 4.5-6 hours) battery capacity remains.
	Indicates 39-63% (approx. 2.5-4.5 hours) battery capacity remains.

Table 5. Battery Fuel Gauge Levels

Level	Description
	Indicates 14-38% (approx. 1-2.5 hours) battery capacity remains.
	Indicates 1-13% (less than 1 hour) battery capacity remains.

The levels in Table 5 are based on a new battery. As a battery is used and recharged over time, it may provide only 75% capacity of a new battery. For example, a battery that is two years old may provide only 75% (3 bars) of the capacity of a new battery.

Low Battery Indicator

Caution

Have a qualified service technician replace the internal battery every 24 months. The lead acid battery is recyclable. Do not dispose of the battery by placing it in the regular trash. Dispose of the battery in accordance with local guidelines or contact Nellcor's Technical Services department to arrange for disposal.

Caution

The pulse oximeter default settings return to factory default settings with a fully discharged or replaced battery. Have a qualified service technician reset the oximeter to match the institutional defaults, following the instructions in the *N-600x Service Manual*.

Note:

If the AC voltage selector switch on the oximeter rear panel does not match your AC voltage source, the oximeter may run on battery power, even though it is connected to an AC power source, which eventually results in a low priority alarm and a lighted low battery indicator. Ensure that the switch setting matches your AC voltage.

- The Low Battery Indicator lights and a low priority alarm begins to sound when approximately 15 minutes of monitoring time remain on the existing battery charge.

  Refer to Table 5 for a description of the low and critical battery conditions. When the battery capacity reaches a critically low battery condition, the Low Battery Indicator flashes and a high priority alarm sounds for about ten seconds before the oximeter shuts off.

  Cancel a low battery audible alarm by pressing the ALARM SILENCE key. The low battery indicator and display screen message continue to display. Silence the audible alarm by connecting the oximeter to an AC power source. The low battery indicator remains lit as long as the battery is in a low voltage condition.

  If the oximeter backlight is turned off during a low battery condition, the backlight cannot be turned back on until connected to an AC power source.

Note:

As the battery is used and recharged over time, the amount of time between the onset of the low battery alarm and the oximeter shut-off may become shorter.

Powering the Oximeter

Power Prerequisites

Caution

If any indicator or display element does not light when the pulse oximeter is turned on, do not use the pulse oximeter. Instead, contact qualified service personnel, your local Nellcor representative, or Nellcor's Technical Services Department.

Caution

During POST (immediately after power-up), confirm that all indicators light, all display segments turn on, and the pulse oximeter speaker sounds a sequence of three ascending tones. After the POST process completes, verify that a single one-second tone sounds.

Before using the oximeter in a clinical setting, verify the oximeter is safe and working properly. Verify proper working condition at each power up by following the procedure below.

Power-on Self -Test (POST)

At power on, the OxiMax N-600x pulse oximeter performs a power-on self-test (POST), which tests the oximeter circuitry and functions, then proceeds to the default display. With a sensor cable and an OxiMax pulse oximetry sensor attached, the unit is ready to register and record patient trend data.

Note:

Physiological conditions, medical procedures, or external agents such as dysfunctional hemoglobin, arterial dyes, low perfusion, dark pigment, and externally applied coloring agents such as nail polish, dye, or pigmented cream may interfere with the oximeter's ability to detect and display measurements.

To power up the oximeter

WARNING

If you do not hear the power-on self-test (POST) pass tone, do not use the oximeter. Instead, contact Nellcor's Technical Service or your local Nellcor representative.

WARNING

Ensure the speaker is clear of any obstructions. Failure to do so could result in an inaudible alarm tone.

Note:

In addition to serving as the POST pass verification, the POST pass tone also functions as an audible confirmation that the speaker is performing properly. If the speaker does not function, the alarm warning sounds cannot be heard.

1. Turn on the oximeter by pressing the ON/STANDBY key.
2. Ensure all of the front panel indicators illuminate for about two seconds.
3. Observe the LCD screen for the POST splash screen, which displays for approximately five seconds.

4. Listen for three ascending tones then a one-second beep, indicating proper operation of the speaker and successful completion of the power-on self-tests.

Figure 15. POST Splash Screen

Note:

The firmware version shown above is only a sample. Check the oximeter for the currently installed firmware version and record it prior to contacting technical assistance. Always have it available when contacting Nellcor's Technical Services Department or a local Nellcor representative for technical assistance.

If the oximeter detects an internal problem during the POST process, an error tone sounds and the oximeter displays an error code (EEE) and the corresponding number. See *Troubleshooting*, page 105.

Figure 16. Error Condition Screen, Battery Failure

Note:

Physiological conditions, medical procedures, or external agents that may interfere with the monitor's ability to detect and display measurements, include dysfunctional hemoglobin, arterial dyes, low perfusion, dark pigment, and externally applied coloring agents such as nail polish, dye, or pigmented cream.

Automatic Shutdown and Power Off

Automatic Shutdown

When all of the following conditions are present for 15 minutes, the OxiMax N-600x pulse oximeter automatically shuts down.

- The oximeter is running on battery power.
- No buttons have been pressed.
- No pulse is detected (for example, when a patient is not connected to the OxiMax pulse oximetry sensor or the pulse oximetry sensor is disconnected from the oximeter).
- No alarms are present (other than low battery or a non-correctable error).

Power Off

To turn off the oximeter, hold the ON/STANDBY key until the display darkens and it powers off.

Using OxiMax™ Pulse Oximetry Sensors

For more information on selecting the right pulse oximetry sensor for the specific patient and situation, see *Selecting an OxiMax™ Pulse Oximetry Sensor*, page 93. Consider all possible variables. If still in doubt, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative.

Sensor Detection

WARNING

Do not use any other cables to extend the length of the DOC-10 pulse oximetry cable. Increasing the length of the DOC-10 cable will degrade signal quality and may lead to inaccurate measurements.

WARNING

Use only the Nellcor DOC-10 pulse oximetry cable with the OxiMax N-600x pulse oximeter. Use of another pulse oximetry cable will have an adverse effect on performance. Do not attach any cable that is intended for computer use to the SpO2 sensor port.

WARNING

Use only Nellcor-approved OxiMax pulse oximetry sensors and pulse oximetry cables when connecting to the sensor connector. Connecting any other cable or sensor influences the accuracy of sensor data, which may lead to adverse results.

When an OxiMax pulse oximetry sensor is connected to the oximeter, a "SENSOR TYPE: xxxx" message displays for between four and six seconds at the bottom of the oximeter display. The message identifies the type (model) of pulse oximetry sensor connected to the oximeter. The type is used to determine the action messages in the sensor message(s) function. For a pulse oximetry sensor containing data, the message identifies the sensor data type. For a blank pulse oximetry sensor, the message identifies the oximeter's current setting used to write data to the sensor. The settings are SpO2 and SpO2+BPM.

Figure 17. Sensor Type Message Display

Note:
The type of data recorded is only displayed when data are present in the OxiMax pulse oximetry sensor.

The oximeter displays zeros in the %SpO2 and Pulse Rate displays while searching for a valid pulse. For optimal performance, allow the oximeter to search and lock onto a pulse for approximately five to ten seconds.

When a valid pulse is detected, the oximeter enters monitoring mode and displays patient parameters using one of the available displays: general care format (factory default display view), waveform, blip bar, or real-time trend view. The SatSeconds icon appears in each display screen when enabled. If the SPD feature is enabled, both the SatSeconds and SPD icons appear in each display. See *Oximeter Display View Options*, page 23.

The movement of the blip bar, the plethysmographic waveform, or the flashing heart icon indicates real-time data display. The pulse beep tone is an audible indicator of the real-time patient data.

Caution
If the pulse beep tone does not sound with each pulse, the pulse beep volume is set to zero, the speaker is malfunctioning, or the signal is corrupt.

When first applying an OxiMax pulse oximetry sensor to a patient, the oximeter may lose a pulse signal. If a pulse signal is lost, an alarm sounds and a poor signal condition message displays on the oximeter screen. At this point, the oximeter displays [--- / ---](three dashes over three dashes) and remains in Pulse Search mode for five seconds before displaying the poor signal condition screen. The poor signal condition screen is part of the Sensor Messages feature.

Figure 18. Poor Signal Condition Message

POX_10011_A

Sensor Detection Failure

Upon successful completion of the POST process, the oximeter sounds a one-second tone indicating that the oximeter has passed POST.

Should the oximeter fail to detect an OxiMax pulse oximetry sensor, the oximeter displays dashes [- - -] and the Pulse Search indicator does not light.

Managing the Oximeter Backlight

Adjust the brightness, contrast, and backlight of the oximeter screen to suit each individual situation.

To turn off the oximeter backlight

1. Press the LIGHT softkey.
2. Then press OFF.

Note:

Any of the following conditions turns on the backlight:

- Pressing any of the softkeys
- Pressing and holding the HELP/CONTRAST key
- Pressing the ALARM SILENCE key
- Any alarm

To adjust the backlight brightness

1. With the oximeter in the normal monitoring mode, press the LIGHT softkey.
2. Press the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter panel until the desired backlight brightness is obtained.

To adjust the oximeter screen contrast

1. With the oximeter in the normal monitoring mode, press and hold the HELP/CONTRAST key for about two seconds, then press the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter panel until obtaining the desired contrast.
2. Press the HELP/CONTRAST key to return to the normal monitoring mode.

Managing the View Display

Select the preferred method of viewing real-time data. Reference *Oximeter Display View Options*, page 23, for details. Selections last until power-cycle or until manual selection of another view.

Using the General Care Format (GCF) Display

General Care Format (GCF) Display Overview

This is the factory default display view. Use the GCF display for large, easy-to-read monitoring information. The GCF display includes the pulse amplitude blip bar, current measured %SpO_2 and pulse rate, and current upper and lower SpO_2 and pulse rate limits. It also includes a battery fuel gauge if running on battery power. If enabled, SatSeconds and SPD icons display.

- **SatSeconds feature**—For mild or brief SpO_2 limit violations, use the SatSeconds feature to reduce nuisance alarms. With the SatSeconds feature enabled, the SatSeconds circle icon fills in the clockwise direction as the SatSeconds alarm management system detects SpO_2 readings outside of the limit setting. The SatSeconds circle icon empties in counterclockwise direction when SpO_2 readings are within limits. When the icon reaches full, a medium priority alarm sounds. For more information about using the feature, reference *Using the SatSeconds™ Alarm Management Feature*, page 65.

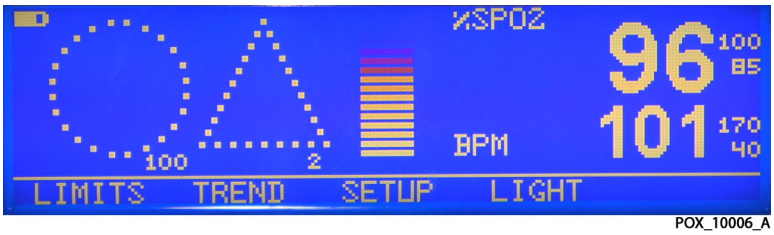
- **SPD feature**—Use the OxiMax SPD™ Alert (SPD) feature to detect patterns of desaturation in the SpO_2 trend in adults. With the SPD feature enabled, the display view includes both the SatSeconds circle icon and SPD triangle icon and their settings. The SPD alarm sensitivity value appears just below the SPD icon. When the SPD feature is enabled, the triangle icon fills from the bottom to the top as desaturation patterns develop. The triangle icon empties from the top to the bottom as patterns dissipate. If the SPD icon reaches full, it indicates a threshold violation and the SPD alarm sounds. The oximeter will sound the SPD alarm sooner if the SPD alarm sensitivity is set to the default value of one (1). A less sensitive setting will result in less frequent alarms. Visible when the SPD feature is activated and the SPD feature is enabled. For more information about activation, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. For more information about using the feature, reference *Using the OxiMax SPD™ Alert Feature*, page 61.

When the oximeter is not attached to AC power, it runs on an internal battery. When using the internal battery, a battery fuel gauge appears in the upper left corner of the display.

To select the GCF Display

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the VIEW softkey.
3. Press the NEXT softkey.
4. Press the GCF softkey.

Figure 19. General Care Format Display View



POX_10006_A

Using the Pleth Display

Pleth Display Overview

Use this display view for visual monitoring information in waveform. The plethysmographic (pleth) display includes a "wiper bar" plethysmographic waveform, menu bar, and current measured SpO_2 and pulse rate, upper and lower limit settings. It also includes a battery fuel gauge if running on battery power. Plethysmographic waveforms with peak to peak amplitudes less than ten pulse amplitude units (PAUs) are associated. Refer to *Theory of Operations*, page 121, for a description of the pleth waveform. If enabled, SatSeconds and SPD icons display.

- **SatSeconds feature**—For mild or brief SpO_2 limit violations, use the SatSeconds feature to reduce nuisance alarms. With the SatSeconds feature enabled, the SatSeconds circle icon fills in the clockwise direction as the SatSeconds alarm management system detects SpO_2 readings outside of the limit setting. The SatSeconds circle icon empties in counterclockwise direction when SpO_2 readings are within limits. When the icon reaches full, a medium priority alarm sounds. For more information about using the feature, reference *Using the SatSeconds™ Alarm Management Feature*, page 65.

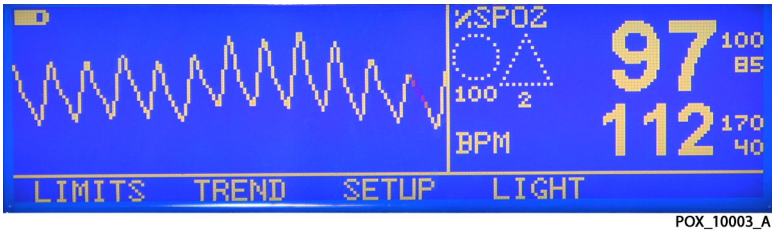
- **SPD feature**—Use the OxiMax SPD™ Alert (SPD) feature to detect patterns of desaturation in the SpO_2 trend in adults. With the SPD feature enabled, the display view includes both the SatSeconds circle icon and SPD triangle icon and their settings. The SPD alarm sensitivity value appears just below the SPD icon. When the SPD feature is enabled, the triangle icon fills from the bottom to the top as desaturation patterns develop. The triangle icon empties from the top to the bottom as patterns dissipate. If the SPD icon reaches full, it indicates a threshold violation and the SPD alarm sounds. The oximeter will sound the SPD alarm sooner if the SPD alarm sensitivity is set to the default value of one (1). A less sensitive setting will result in less frequent alarms. Visible when the SPD feature is activated and the SPD feature is enabled. For more information about activation, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. For more information about using the feature, reference *Using the OxiMax SPD™ Alert Feature*, page 61.

When the oximeter is not attached to AC power, it runs on an internal battery. When using the internal battery, a battery fuel gauge appears in the upper left corner of the display.

To select the Pleth Display

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the VIEW softkey.
3. Press the PLETH softkey.

Figure 20. Pleth Display View



POX_10003_A

Using the Blip Display

Blip Display Overview

Use this display view for visual monitoring information in blip bar form. The blip display includes a pulse amplitude blip bar, current measured SpO_2 and pulse rate, current upper and lower SpO_2 and pulse rate limits. It also includes a battery fuel gauge if running on battery power. If enabled, SatSeconds and SPD icons display.

- **SatSeconds feature**—For mild or brief SpO_2 limit violations, use the SatSeconds feature to reduce nuisance alarms. With the SatSeconds feature enabled, the SatSeconds circle icon fills in the clockwise direction as the SatSeconds alarm management system detects SpO_2 readings outside of the limit setting. The SatSeconds circle icon empties in counterclockwise direction when SpO_2 readings are within limits. When the icon reaches full, a medium priority alarm sounds. For more information about using the feature, reference *Using the SatSeconds™ Alarm Management Feature*, page 65.
- **SPD feature**—Use the OxiMax SPD™ Alert (SPD) feature to detect patterns of desaturation in the SpO_2 trend in adults. With the SPD feature enabled, the display view

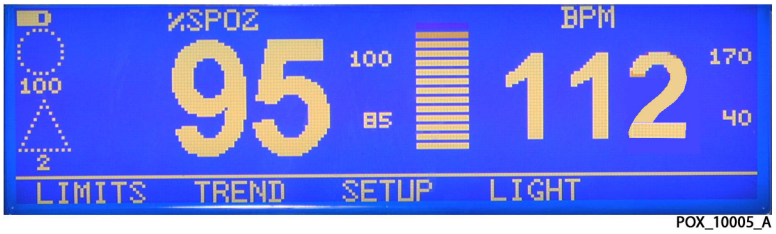
includes both the SatSeconds circle icon and SPD triangle icon and their settings. The SPD alarm sensitivity value appears just below the SPD icon. When the SPD feature is enabled, the triangle icon fills from the bottom to the top as desaturation patterns develop. The triangle icon empties from the top to the bottom as patterns dissipate. If the SPD icon reaches full, it indicates a threshold violation and the SPD alarm sounds. The oximeter will sound the SPD alarm sooner if the SPD alarm sensitivity is set to the default value of one (1). A less sensitive setting will result in less frequent alarms. Visible when the SPD feature is activated and the SPD feature is enabled. For more information about activation, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. For more information about using the feature, reference *Using the OxiMax SPD™ Alert Feature*, page 61.

When the oximeter is not attached to AC power, it runs on an internal battery. When using the internal battery, a battery fuel gauge appears in the upper left corner of the display.

To select the Blip View

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the VIEW softkey.
3. Press the BLIP softkey.

Figure 21. Blip Display View



POX_10005_A

Using the Real-Time Trend Display

Real-Time Trend Display Overview

Use this display view for visual monitoring information related to real-time trends. The trend data plots automatically update as the oximeter calculates each new trend point, where the interval between calculations is based on the display time scale selected. The real-time trend display includes SpO_2 and/or pulse rate trend data plots, current measured SpO_2 and pulse rates. It also includes a battery fuel gauge if running on battery power. Each time the oximeter detects a pulse, the heart icon flashes. If enabled, SatSeconds and SPD icons display.

- **SatSeconds feature**—For mild or brief SpO_2 limit violations, use the SatSeconds feature to reduce nuisance alarms. With the SatSeconds feature enabled, the SatSeconds circle icon fills in the clockwise direction as the SatSeconds alarm management system detects SpO_2 readings outside of the limit setting. The SatSeconds circle icon empties in counterclockwise direction when SpO_2 readings are within limits. When the icon reaches full, a medium priority alarm sounds. For more information about using the feature, reference *Using the SatSeconds™ Alarm Management Feature*, page 65.
- **SPD feature**—Use the OxiMax SPD™ Alert (SPD) feature to detect patterns of saturation in the SpO_2 trend in adults. With the SPD feature enabled, the display view includes both

the SatSeconds circle icon and SPD triangle icon and their settings. The SPD alarm sensitivity value appears just below the SPD icon. When the SPD feature is enabled, the triangle icon fills from the bottom to the top as desaturation patterns develop. The triangle icon empties from the top to the bottom as patterns dissipate. If the SPD icon reaches full, it indicates a threshold violation and the SPD alarm sounds. The oximeter will sound the SPD alarm sooner if the SPD alarm sensitivity is set to the default value of one (1). A less sensitive setting will result in less frequent alarms. Visible when the SPD feature is activated and the SPD feature is enabled. For more information about activation, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. For more information about using the feature, reference *Using the OxiMax SPD™ Alert Feature*, page 61.

When the oximeter is not attached to AC power, it runs on an internal battery. When using the internal battery, a battery fuel gauge appears in the upper left corner of the display.

To select the Real-Time Trend View

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the VIEW, then NEXT softkeys.
3. Press the TREND softkey. The real-time trend view displays.

Figure 22. Real-time Trend Display View

POX_10039_A

To set up the Trend Data Display

1. Press the SETUP softkey.
2. Press the VIEW, then NEXT softkeys.
3. Press the TREND softkey.
4. Press the VIEW softkey.

5. Press any of the trend softkeys (DUAL, SpO2, or PULSE).
   a. **DUAL option**—Displays both %SpO2 and BPM trends simultaneously in a split screen.

Figure 23. Dual Trend Data Split Screen, 2 hour

   b. **SpO2 option**—Shows just the %SpO2 trend data.

Figure 24. SpO2 Trend Data, 30 minute

   c. **PULSE option**—Shows just the pulse trend data.

Figure 25. Pulse Trend Data, 30 minute

To set up the Trend Time Scale Display

1. Press the SETUP softkey.
2. Press the VIEW, then NEXT softkeys.
3. Press the TREND softkey.
4. Press the ZOOM softkey.
5. Press the TIME softkey to cycle the displayed trend time scale through 48 hours, 36 hours, 24 hours, 12 hours, 8 hours, 4 hours, 2 hours, 1 hour, 30 minutes, and 15 minutes.

To set up the Trend Amplitude Scale Display

1. Press the SETUP softkey.
2. Press the VIEW, then NEXT softkeys.
3. Press the TREND softkey.
4. Press the ZOOM softkey.

5. Press the SCALE softkey to cycle the trend amplitude scale display through ±5 points, ±10 points, ±15 points, ±20 points, ±25 points, ±30 points, ±35 points, ±40 points and ±50 points above and below the newest, rightmost trend data point.

Note:

You can set the trend amplitude scale to AUTO by pressing the AUTO softkey. The maximum trend data point is rounded up to the nearest multiple of ten, shown at the top of the graph display. The minimum trend data point is rounded down to the next multiple of ten. Ten is then subtracted from the rounded down number. This value is located at the bottom of the trend graph.

Adjusting the Volume of Audible Tones

Adjusting the Pulse Beep Volume

The pulse beep emits its tone with each real-time event, based on data received from the sensor.

To adjust the pulse beep volume

1. With the oximeter in the normal monitoring mode, press and hold the ADJUST UP key below the ALARM SILENCE key on the oximeter panel to increase the pulse beep volume.
2. With the oximeter in the normal monitoring mode, press and hold the ADJUST DOWN key to decrease the pulse beep volume.

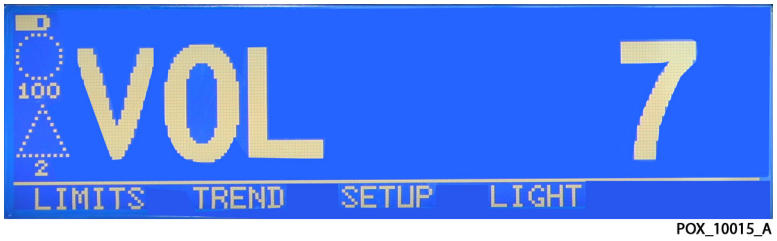
Managing Oximeter Alarms

Alarms occur when the oximeter detects a condition that requires user intervention or attention. The Alarm Volume allows for volume adjustment of alarm tones.

To set the alarm volume

1. With the oximeter in the normal monitoring mode, press the ALARM SILENCE key until the alarm volume level displays and sounds on the oximeter.

Figure 26. Alarm Volume Control Screen



POX_10015_A

2. While continuing to press the ALARM SILENCE key, press and hold the ADJUST UP or ADJUST DOWN key to increase or decrease the volume.

Note:

Default alarm volume is seven (7). Select the appropriate value for the situation. The alarm volume adjusts up to ten (10) and down to one (1).

Managing Audible Alarms

To set the alarm silence duration

The Alarm Silence Duration display enables you to adjust the alarm silence duration.

1. With the oximeter in the normal monitoring mode, press the ALARM SILENCE key until the alarm silence duration setting displays. The alarm silence durations available are 30-, 60-, 90-, and 120-second intervals.

Figure 27. Alarm Silence Duration Screen

POX_10013_A

2. Press and hold the ALARM SILENCE key and the ADJUST UP key below the ALARM SILENCE key on the oximeter panel to increase the alarm silence duration setting.
3. Press and hold the ALARM SILENCE key and the ADJUST DOWN key to decrease the alarm silence duration setting.

Note:

Releasing the ADJUST UP or ADJUST DOWN key sets the alarm silence duration.

Note:

Default alarm silence duration is 60 seconds. Select the appropriate value for the situation. The alarm silence duration adjusts up to 120 seconds and down to 30 seconds.

To disable audible alarms

WARNING

Do not disable the audible alarm function or decrease the audible alarm volume if the patient's safety could be compromised.

WARNING

Pressing ALARM SILENCE will keep ALL alarms from sounding for the alarm silence duration period.

Note:

The ability to set the alarm silence duration to OFF can be enabled or disabled by qualified service personnel as described in the *N-600x Service Manual*.

1. With the oximeter in the normal monitoring mode, press the ALARM SILENCE key until the alarm silence duration setting displays.
2. While pressing the ALARM SILENCE key, press and hold the ADJUST UP key until OFF displays. Release both keys.

Note:

Once audible alarms are disabled, the orange LED above the ALARM SILENCE key lights to indicate the disabled alarm state.

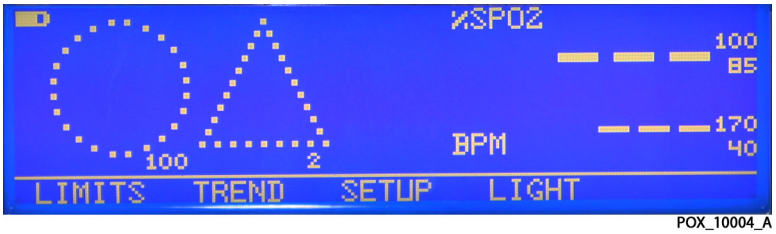
To select the standby mode

Normally, use the standby mode setting for the patient who must temporarily leave the oximeter.

The standby mode enables the oximeter to retain alarm limit settings in effect when a caregiver temporarily removes a patient's sensor.

1. Verify the oximeter alarm limits are configured to the monitored patient.
2. Disconnect the sensor from the oximeter.
3. Press the ALARM SILENCE key to silence the audible alarms.
4. Press the ALARM SILENCE key to disable the alarm messages.

Figure 28. Standby Mode



POX_10004_A

The oximeter is now in the standby mode. Reconnect the sensor to the oximeter and the patient to return to normal monitoring.

Using Oximeter Softkey Menus

Navigating Menu Options

Hierarchy

The oximeter's softkey menu hierarchy allows the user or technician to configure and operate the oximeter, select options, and view trend or event data.

Note:

The oximeter compiles trend data on each entry or re-entry to the Trend menu. To refresh active trend data, re-enter the Trend menu from the Main menu.

Sensor sub-menu choices differ, depending on what type of patient alarm event data are stored in the sensor chip.

Common Menu Options

1. **BACK softkey**— Return to the previous menu level without exiting the selected menu area entirely.
2. **NEXT softkey**—Proceed to the next screen of menu options for that menu set.

3. **EXIT softkey**—Exit to the main menu or press BACK until you reach an EXIT menu option.

Main Menu

The main menu softkey options provide access to several submenus.

Figure 29. Main Menu Options

POX_10004_A

1. **LIMITS Menu**—Select standard oximeter upper and lower SpO2 or pulse rate limits and alarm management settings for either adults or neonates.
2. **TREND Menu**—Select method of viewing oximeter trend and sensor data.

Note:

In the case of a SatSeconds or an SPD event, the oximeter proceeds straight to the MONITR menu. Clear any alarm condition(s) to access the TREND menu.

3. **SETUP Menu**—Use this softkey to control oximeter viewing options, sensor setup, clock setup and language viewing options. Also configure the communication port, the nurse call feature, and control analog voltage.
4. **LIGHT Menu**—Leave the display backlight on, adjust brightness, or choose to turn the display backlight off.

LIMITS Menu

Figure 30. Limit Menu Options for Neonates

POX_10021_A

1. **SELECT softkey**—Use this softkey only after you have chosen the NEO screen or the ADULT screen using the appropriate softkey. Then, use the SELECT softkey to scroll through each limit setting option until you reach the limit value you wish to change.
2. **NEO softkey**—Use this softkey to set upper and lower limits for neonates. Scroll through each limit setting option using the SELECT softkey until you reach the limit value you wish to change. Change the value by pressing the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter panel until you reach the desired value. This setting only holds until power recycle. Decimal points to the right of the displayed values indicate those limits have been

modified from the power-on default values. See *Adjusting the Factory Default Settings* on page 56.

a. **Upper and Lower SpO2 Limits**—The neonate default upper limit is 95% and the lower limit is 85%. An alarm sounds each time patient saturation violates these alarm limits.

b. **SatSeconds Alarm Management**—The neonate default SatSeconds value is OFF. Reference *Using the SatSeconds™ Alarm Management Feature*, page 65.

c. **OxiMax SPD™ Alert (SPD) Feature**—This option is not available for neonates. Reference *Using the OxiMax SPD™ Alert Feature*, page 61.

d. **Upper and Lower Pulse Rate Limits**—The neonate default upper limit is 190 bpm and the lower limit is 90 bpm. An alarm sounds each time patient pulse rate violates these alarm limits.

e. **Pulse Rate Delay Alarm Management**—The neonate default Pulse Rate Delay is OFF, but can be set to a five (5) or ten (10) second pulse rate alarm delay. Reference to *Using the Pulse Rate Delay Alarm Management Feature*, page 64.

3. **ADULT softkey**—Use this softkey to set upper and lower limits for adult and pediatric patients. Scroll through each limit setting option using the SELECT softkey until you reach the limit value you wish to change. Change the value by pressing the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter panel until you reach the desired value. This setting only holds until power recycle. Decimal points to the right of the displayed values indicate those limits have been modified from the power-on default values. See *Adjusting the Factory Default Settings* on page 56.

   a. **Upper and Lower SpO2 Limits**—The adult default upper limit is 100% and the lower limit is 85%. An alarm sounds each time patient saturation violates these alarm limits.

   b. **SatSeconds Alarm Management**—The adult default SatSeconds value is 100 SatSeconds. For more information, refer to *Using the SatSeconds™ Alarm Management Feature*, page 65.

   c. **OxiMax SPD™ Alert (SPD) Feature**—The SPD feature is not indicated for use on pediatric patients, but on adult patients only. The adult default SPD alarm sensitivity is a value of one (1) for most sensitive to patterns of desaturation. For more information, refer to *Using the OxiMax SPD™ Alert Feature*, page 61. When SPD is enabled, the SatSeconds feature is automatically enabled with a setting of 100.

   d. **Upper and Lower Pulse Rate Limits**—The adult default upper limit is 170 bpm and the lower limit is 40 bpm. An alarm sounds each time patient pulse rate violates these alarm limits.

   e. **Pulse Rate Delay Alarm Management**—The adult default Pulse Rate Delay is OFF, but can be set to a five (5) or ten (10) second pulse rate alarm delay. For more information, refer to *Using the Pulse Rate Delay Alarm Management Feature*, page 64.

TREND Menu

Choose the type of trend data to view by selecting trend data from the oximeter (MONITR) or trend data from the pulse oximetry sensor (SENSOR) in the Trend menu.

1. **MONITR Menu**—Isolate oxygenation (SpO2) or pulse (PULSE) trend data or view them both together (DUAL) for a specified length of time. Establish trend data parameters for specific time segments and set minimum and maximum trend values.
   a. **VIEW Menu**—Isolate oxygenation (SpO2) or pulse (PULSE) trend data or view them both together (DUAL). Access the HIST and Amplitude submenus by selecting the NEXT Option.
      - **DUAL softkey**—View oxygenation (SpO2) and pulse (PULSE) trend data together for a specified length of time.
      - **SpO2 softkey**—Isolate oxygenation (SpO2) trend data for a specified length of time.
      - **PULSE softkey**—Isolate pulse (PULSE) trend data for a specified length of time.
      - **HIST softkey**—Choose to delete or keep current trend data history. To delete, select YES. To keep, select NO and return to the HIST menu, go BACK, or EXIT to the Main Menu.
      - **AMP softkey**—Set the trend data view to "Pulse Amplitude Units" (PAU) using the AMP (amplitude) Menu. This is an arbitrary unit of measure gauging the distance from the peak to the valley of a pulse waveform. The trend data when set to PAU can register amplitudes up to 200 PAU.
   b. **ZOOM Menu**—Access to the TIME option, SCALE option, AUTO option, and BACK option if the trend view is set in DUAL, SpO2, or PULSE mode.

Note:
The ZOOM menu will not allow access to the options listed if it is in AMP mode. SCALE and AUTO options do not appear as options without trend data history to review.

- **TIME softkey**—Select from hours to minutes to seconds for viewing a specific time segment of trend data. Cycle through the options by pressing the TIME softkey. The options proceed in the following order: 48h, 36h, 24h, 12h, 8h, 4h, 2h, 1h, 30m, 15m, 40s, or 20s.
- **SCALE softkey**—Select the maximum and minimum values for the SpO2 or PULSE trend graph. Default SpO2 trend values are 10 to 100. Default PULSE trend values are 5 to 250. Cycle through the options by pressing the Select softkey. The options proceed in the following order: ±5, ±10, ±15, ±20, ±25, ±30, ±35, ±40 and ±50 units variance.
- **AUTO softkey**—Obtain the maximum and minimum rounded values based on all graphed trend data.
- **DELETE softkey**—Choose to delete or keep current trend data. To delete, select YES. To keep, select NO and return to the previous menu.

2. **SENSOR Submenu**—The SENSOR menu is only available when using a single-patient OxiMax adhesive pulse oximetry sensor. After connecting an OxiMax

adhesive pulse oximetry sensor, the bottom indicator on the left will blink for 60 seconds.

a. **GRAPH softkey**—Display events in reverse chronological order from top to bottom of the display. View previous or next graphs if available. Return to the SENSOR Menu using the BACK softkey.

b. **TABLE softkey**—Display events in graph form. Show previous or next tables if available. PRINT table data or go BACK to the SENSOR Menu.

SETUP Menu

Use the SETUP menu to choose the preferred display screen, set temporary limits and sensitivity, set oximeter time and date, select the preferred language, or select the communication protocol, nurse call features, and response mode from the setup menu. With a pulse oximetry sensor that retains the trend data, access the sensor trend history data.

1. **VIEW Menu**—Select plethysmographic waveform, blip display, trend data display or general care format (GCF) display view. Returns to default display after power cycle.
   a. **PLETH softkey**—Access plethysmographic (pleth) waveform display.
   b. **BLIP softkey**—Access blip bar display.
   c. **TREND Menu**—Access trend data display. Similar to MONITR trend view menu option.
      - **VIEW softkey**—Display sensor trend data. Isolate oxygenation (SpO_2 Option) or pulse (PULSE Option) trend data or viewing them both together (DUAL Option).
      - **ZOOM softkey**—Access to the TIME Option, SCALE Option, AUTO Option, and BACK Option if the trend view is set in DUAL, SpO_2, or PULSE mode.
   d. **GCF softkey**—Access the default general care format (GCF) display, which includes the blip bar as well as SpO_2, pulse rate readings and limits, as well as SatSeconds and SPD icons in a large, easy-to-view format.
2. **SENSOR Menu**—Access the sensor trend history menu. This menu is only available if you have a pulse oximetry sensor type that retains the trend data in a chip on the pulse oximetry sensor.
   a. **DATA softkey**—Access the sensor trend history data. The unit identifies which type of pulse oximetry sensor it is, as well as type of available data.
   b. **MSG softkey**—Determine of messaging is enabled or disabled (Yes or No) and review sensor events (Yes or No).
3. **CLOCK Menu**—Access to set the clock, both date and time.

WARNING

The pulse oximetry sensor extrapolates from the date and time provided by the Nellcor OxiMax N-600x pulse oximeter when recording the sensor event record to the sensor. The accuracy of the date/time is determined by the date/time setting of the pulse oximeter. Set the pulse oximeter date and time to the correct value before connecting a record-enabled sensor to keep the date and time consistent for as long as the sensor

remains connected. Since a sensor with sensor event record data can be transported from one oximeter to another, having discrepancies in the date/time between oximeters and the sensor event record data will affect the order in which the sensor event record data appear. To eliminate this potential problem, set all oximeters within an institution to the same time.

To set the date and time

a. With the oximeter in the normal monitoring mode, press the SETUP softkey.

b. Press the NEXT softkey.

c. Press the CLOCK softkey.

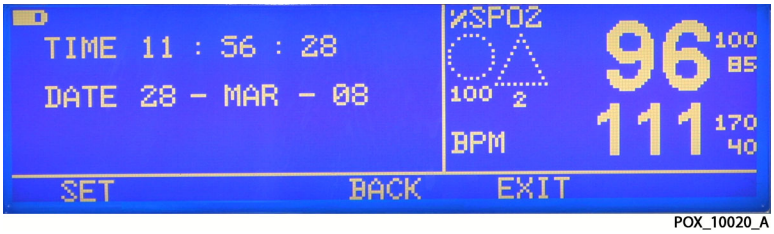
d. Press the SET softkey.

e. Press the SELECT softkey to select the TIME and DATE fields as shown.

TIME HOURS : MINUTES : SECONDS

DATE DAY - MONTH - YEAR

Figure 31. Time and Date Screen



f. Use the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key to change the selected value.

g. Press the EXIT softkey.

4. **LANG Menu**—Select and view one of eleven (11) languages for ease in reading oximeter screens, as well as obtaining and printing client data in the preferred language. Available languages are listed below.

- ENGLISH
- DANSK (Danish)
- DEUTSCH (German)
- ESPAÑOL (Spanish)
- FRANCAIS (French)
- ITALIANO (Italian)
- NEDERLANDS (Dutch)
- NORSK (Norwegian)
- PORTUG (Portuguese)
- SUOMI (Finnish)
- SVERIGE (Swedish)

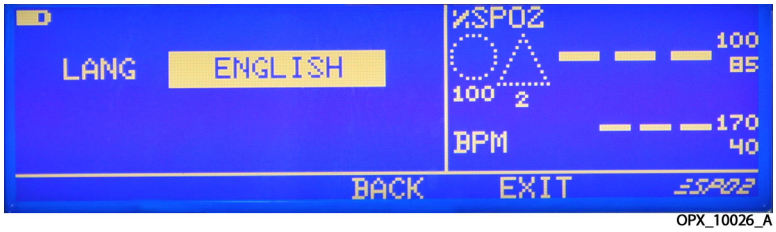
To change the displayed language setting

a. With the oximeter in the normal monitoring mode, press the SETUP softkey.

b. Press the NEXT softkey.

c. Press the LANG softkey.

Figure 32. Displayed Language Selection Screen



d. Use the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to select the desired language.

e. Press the EXIT softkey.

Note:

The selected language displays until the oximeter is turned OFF. Any changes in language selection do not last beyond power-off, but return to default English, unless qualified service personnel set the selected language as a default by following the procedures outlined in the *N-600x Service Manual*.

5. **COMM Menu**—From the SETUP menu, press the NEXT softkey twice. Use the SELECT softkey to toggle between the baud rate and communication protocol. Arrow up or down to select the proper baud rate. Baud rates include 19200, 9600, and 2400 baud for all protocols except SPDout, which allows 115200, 57600, and 19200 baud. Arrow up or down to select the proper communication protocol. The OxiMax N-600x pulse oximeter provides a bedside monitor communication for interfacing with the protocols listed below. The factory default protocol is ASCII.

Table 6. Communication Protocol Options

Communication Protocols	N-600x using up to Firmware 2.0 Default Baud Rate	N-600x with Firmware 2.0 and above Default Baud Rate
ASCII	9600	9600
CLINICAL	19200	19200
GRAPH (Graphics)	9600	N/A
OXINET	9600	N/A
PHILIPS (VueLink)	19200	Use only 19200
SPACELBS (Spacelabs)	9600	N/A
MARQ (GE Marquette)	9600	N/A
DATEX (Datex-Ohmeda)	2400	N/A
SPDout	N/A	Default 115200 Available: 19200, 57600, 115200

6. **NCALL Menu**—From the SETUP menu, press the NEXT softkey twice so the NCALL (Nurse Call) menu option is available. Set voltage from +5 VDC to +12 VDC using Norm + or set voltage from -5 VDC to -12 VDC using Norm- when there is no audible alarm. Voltages switch polarity when the audible alarm sounds. Return to the COMM/NCALL menu using the BACK softkey. Exit to the Main Menu by pressing EXIT.
7. **ANALOG Menu**—From the SETUP menu, press the NEXT softkey three times to reach the ANALOG menu option. Select 0 Volt, 1 Volt, or Step options to calibrate analog signals. Return to the ANALOG/MODE menu using the BACK softkey. Exit to the Main Menu by pressing EXIT.
8. **MODE softkey**—The response mode establishes the frequency the oximeter uses to calculate, record, and display SpO2 saturation levels, but does not affect the calculation of pulse rate. The response mode, however, may impact the SPD alarm behavior. From the SETUP menu, press the NEXT softkey twice to reach the MODE menu option.
    a. **Normal Mode**—Default response mode responds to changes in blood oxygen saturation in five- to seven-seconds when calculating %SpO2. When in Normal Mode, the screen does not display the Fast Mode icon.
    b. **Fast Response Mode**—Fast mode responds to changes in blood oxygen saturation levels in two- to four-seconds when calculating %SpO2. This can be particularly helpful for situations that require close monitoring. The Fast Mode icon in italics appears in the lower right corner of the screen when in Fast Mode.

SPO2

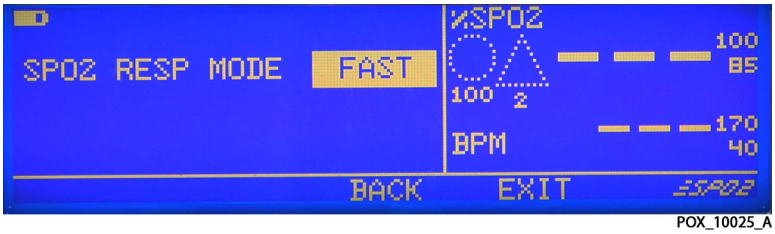
Note:

The response mode display screen includes the current SpO2 response mode setting and the current measured SpO2 and pulse rate. If SatSeconds is enabled, the SatSeconds indicator displays. If SPD is enabled, both SatSeconds and SPD icons will display.

To set the response mode

a. With the oximeter in the normal monitoring mode, press the SETUP softkey.
b. Press the NEXT softkey three times.
c. Press the MODE softkey.

Figure 33. %SpO2 Response Mode Selection Screen



POX_10025_A

Note:
When the oximeter is in the FAST response mode, the oximeter may produce more SpO2 and pulse rate alarms than expected. The response mode, however, may impact the SPD alarm behavior.

d. Use the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to select the desired response mode.

e. Press the EXIT softkey.

LIGHT Menu

1. **OFF softkey**—Use the OFF softkey to turn the backlight off entirely. This option does not remain after power cycle, but returns to the factory default brightness. Use ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to brighten or dim the display backlight.
2. **EXIT softkey**—Exit to the main menu.

Adjusting the Factory Default Settings

Overview

WARNING
Audible alarms should not be silenced if patient safety could be compromised.

WARNING
Each time the pulse oximeter is used, check alarm limits to ensure that they are appropriate for the patient being monitored.

WARNING
The SPD feature is for use with adults patients only. In Neonate Mode, the SPD feature remains OFF.

Caution
Use of the SPD alarm feature does not change the need to set threshold limits appropriate to the patient being monitored.

The OxiMax N-600x pulse oximeter is shipped with factory default settings. Factory default settings are divided into two groups: adult and neonate. The oximeter lists adult-pediatric alarm limit settings rather than neonate settings at power-up. Set the oximeter's operating mode to adult-pediatric or neonatal using the LIMITS softkey. This setting remains active until the oximeter is turned OFF. Have a qualified service technician set institutional default settings, if they are different than the power-on default settings, using the *N-600x Service Manual*.

Use the softkeys to change alarm limits, displays, baud rates, time and date, and trend data views. Some values cannot be saved as power-on default values.

- The oximeter will not accept an %SpO2 Lower Alarm Limit of less than "85" as a power-on default.
- The oximeter will not accept an AUDIBLE ALARM OFF option as a power-on default.

An attempt to save either of these values as default results in an invalid tone. These limits can be adjusted lower for the current patient, but return to power-on defaults at power-off.

Note:

The SPD feature automatically sets the SatSeconds value to 100.

Changing Adult and Neonate Default Settings

Table 7. Adult and Neonate Default Settings

Option	Adult Default Settings	Neonate Default Settings
%SpO2 Lower Alarm Limit	85%	
%SpO2 Upper Alarm Limit	100%	95%
Alarm Silence Duration	60 Seconds	
Alarm Silence Duration OFF Setting	Disabled	
Alarm Silence Reminder	Enabled	
Alarm Volume	7 of 10	
Display Contrast	Midrange	
Display Format	GCF	
Backlight Brightness	8 (Battery Power) 10 (AC Power)	
Language	English	
Pulse Beep Volume	4 of 10	
Pulse Rate Lower Alarm Limit	40 BPM	90 BPM
Pulse Rate Upper Alarm Limit	170 BPM	190 BPM
Pulse Rate Delay	Off	
Allow Pulse Rate Delay	Yes	
Response Mode	Normal	
Sensor Adjust Enable	Yes	
SatSeconds	SPD enabled 100 SPD disabled Off	Off
Allow SatSeconds	Yes	
SPD	SPD enabled 1	Always Off (Disabled)
Allow SPD	Yes	No
Real-Time Trend Display	%SpO2	
Real-Time Trend Scale	15 Minutes	
Trend Scale	8 Hours	
Nurse Call Polarity	Normally Low	
Data Port Baud Rate	9600	
Data Port Protocol	ASCII	

To set adult or neonatal modes

WARNING

Supplemental oxygen will attenuate patterns of desaturation. A patient's respiratory compromise can be proportionally more severe before patterns appear in the saturation trend. Remain vigilant when monitoring a patient on supplemental oxygen.

WARNING

The SPD feature is for use with adults patients only. In Neonate Mode, the SPD feature remains OFF.

1. With the oximeter in the normal monitoring mode, press the LIMITS softkey. The oximeter displays the ADULT LIMITS or NEONATE LIMITS screen, based on institutional or default settings.

   a. The adult limits screen displays the institutional or factory default settings appropriate to adult and pediatric patients.

Figure 34. Setting Adult and Pediatric Limits Screen

POX_10019_A

   b. The neonate limits screen displays the institutional or factory default settings appropriate to neonatal patients.

Figure 35. Setting Neonate Limits Screen

POX_10021_A

2. Press the NEO or ADULT softkey to set the desired ADULT LIMITS or NEONATE LIMITS.

Setting Temporary Limits

The initial values in the limits screen are the factory default settings listed in *Adult and Neonate Default Settings*, page 58, or the institutional default settings set by qualified service personnel. A decimal point (.) immediately follows any modified

value for a particular patient in the limits screen. These values return to the factory or institutional default values after power cycle.

Figure 36. Setting Adult Limits Screen

POX_10019_A

To set limits

1. To adjust the upper and lower saturation and pulse rate limits, select the Adult or Neonate Limit display. The Limit display includes the alarm limit table and current measured SpO2 and pulse rates. The title of the alarm limit table indicates whether the oximeter is in Adult or Neonate monitoring mode. If SatSeconds or SPD are enabled, the Limit display also includes the SatSeconds and SPD icons.

Note:

Limit changes remain in effect as long as the oximeter power continues, but return to the institutional default limits when oximeter power is turned off. Only qualified service personnel may change factory defaults to institutional defaults by following the procedures outlined in the *N-600x Service Manual*.

2. Press the LIMITS softkey.
   a. When Adult Limits are selected, the following current limits display.

Figure 37. Adult and Pediatric Limits Screen

POX_10019_A

   b. When Neonate Limits are selected, the following current limits display.

Figure 38. Neonate Limits Screen

POX_10021_A

3. Press the ADULT or NEO softkey to select the Adult-Pediatric or Neonatal Limits screen.
4. Press the SELECT softkey to select the parameter to be adjusted.

5. Use the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to increase or decrease the selected limit parameter.
6. Repeat steps as necessary to complete the alarm limits setup.
7. Wait for the display to time-out to accept the changes or press the EXIT softkey to close the display and return to the normal monitoring mode.

Using the OxiMax SPD™ Alert Feature

How the OxiMax SPD™ Alert Feature (SPD) Works

WARNING

Supplemental oxygen will attenuate patterns of desaturation. A patient's respiratory compromise can be proportionally more severe before patterns appear in the saturation trend. Remain vigilant when monitoring a patient on supplemental oxygen.

WARNING

The SPD feature is for use with adults patients only. In Neonate Mode, the SPD feature remains OFF.

Caution

Use of the SPD alarm feature does not change the need to set threshold limits appropriate to the patient being monitored.

The OxiMax SPD™ Alert (SPD) feature detects patterns of desaturation in adults that are indicative of repetitive reductions in airflow through a patient's upper airway into the lungs. Relative reductions in a patient's minute ventilation over a period of time may cause a progressive drop in alveolar partial pressure of oxygen, leading to arterial desaturation. If these decreases in ventilation are repetitive, they generate distinct patterns in the saturation trend. Patterns of repetitive desaturation often develop gradually over time, increasing in severity. Detection of patterns indicates that a patient might be suffering progressively severe decrements in airflow that may increase in acuity if left untreated.

Patterns of desaturation are multiple, sequential occurrences of a desaturation followed by a resaturation. The SPD feature qualifies patterns of desaturation resulting from such repetitive reductions in airflow based on specific characteristics.

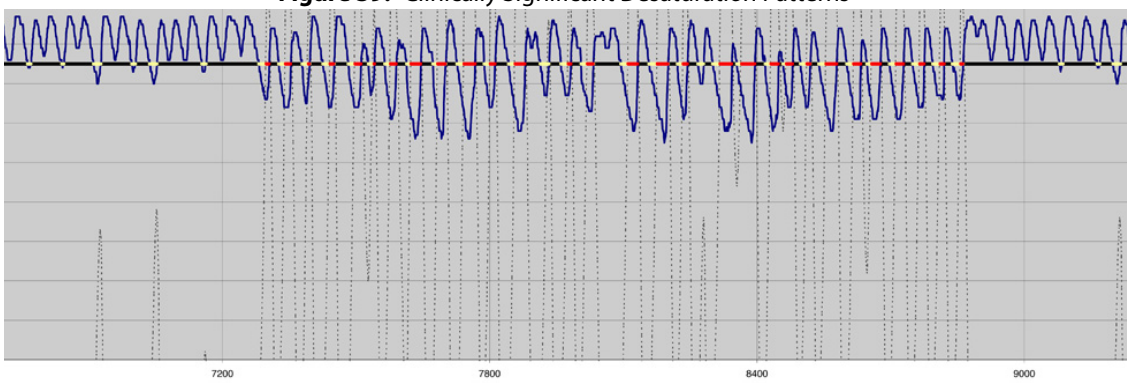
- The severity of the desaturation event (the depth of the desaturation during the event) and the extent of the following resaturation
- The regularity of the desaturation events (how often the pattern repeats)
- The slope of the desaturation/resaturation trends that form the events

Note:

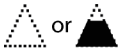
Unrecognized repetitive reductions in airflow through the upper airway occur in some clinically significant scenarios. Patients exhibiting sleep apnea symptoms were used in studies to validate the SPD feature. The presence of repetitive reductions in airflow was scored using a standard diagnostic polysomnogram. Study results indicate SPD is a sensitive marker in detecting repetitive reductions in airflow.

The SPD feature qualifies these patterns of desaturation over a period of six (6) minutes. Depending on the sensitivity setting for SPD, patterns that persist may result in an SPD alarm, alerting the caregiver to the condition.

Figure 39. Clinically Significant Desaturation Patterns

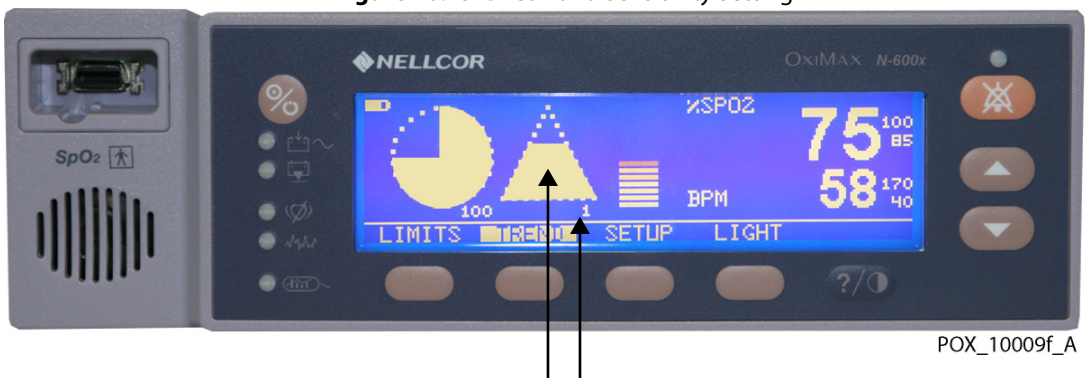


The SPD feature communicates information to the caregiver about these patterns of desaturation in a variety of ways.



1. **SPD icon**—When the OxiMax SPD™ Alert (SPD) feature detects patterns of desaturation in the SpO2 trend in adults, caregivers are alerted to these patterns via a visual indicator, and optionally, an audio alarm. The triangle icon for SPD appears on the monitor display when the feature is enabled. The triangle fills from the bottom to the top as patterns become more severe. The triangle empties from top to bottom as the patterns become less severe. If the triangle fills, an alarm sounds. With SPD enabled, the default setting is On with the sensitivity set to 1. The feature can be turned off in the LIMITS menu. Caregivers can select from three alarm sensitivity settings: 1 (most sensitive), 2 (medium sensitivity) or 3 (least sensitive), with 1 resulting in more alarms and 3 resulting in fewer alarms. The rate at which the SPD icon fills depends on the SPD sensitivity setting.

Figure 40. SPD Icon and Sensitivity Setting



2. **SPD** alarms—SPD alarm settings include both audible and visual alarms. Caregivers may set the alarm type to both audible and visual, or set to visual only.
   a. Audible alarm—Once an audible SPD alarm occurs, the oximeter will continue to alarm for up to six (6) minutes after the alarm triggers or until the caregiver silences the alarm.
   b. Visual alarm—Once an SPD visual alarm occurs, the TREND softkey continues to flash until the caregiver presses the TREND softkey to review the trend data.

3. **SPD** trend data—The trend history captures the SPD patterns and defines periods when the SatSeconds and SPD alarms were activated. Once patterns exceed the SPD limit, the TREND menu option will flash. Caregivers should view the data to examine SatSeconds and SPD patterns in the trend data history. To change the amount of time visible in the trend view, press the TIME softkey to change time scale.

Figure 41. SPD Trend Data, 15 minute

When the indicator reaches capacity, indicating the SPD limit has been reached, an audible alarm sounds and the TREND softkey flashes. The TREND softkey continues to flash until the caregiver presses the TREND softkey to review the trend data. The default setting of one (1) is the most sensitive to desaturation patterns and results in more frequent alarms. For less frequent alarms, use a less sensitive setting of two (2) or three (3).

To set the OxiMax SPD™ Alert (SPD) sensitivity

WARNING

Supplemental oxygen will attenuate patterns of desaturation. A patient's respiratory compromise can be proportionally more severe before patterns appear in the saturation trend. Remain vigilant when monitoring a patient on supplemental oxygen.

WARNING

The SPD feature is for use with adults patients only. In Neonate Mode, the SPD feature remains OFF.

The SPD sensitivity setting establishes a threshold for how sensitive the oximeter is to patterns of desaturation. The default setting of one (1) is the most sensitive.

Note:

When SPD is enabled, the SatSeconds feature is automatically enabled with a setting of 100.

Note:

The ability to adjust the alarm limit default settings can be enabled or disabled by qualified service personnel as described in the *N-600x Service Manual*.

Note:

Prior to changing SPD sensitivity settings, clear all alarms.

With the oximeter in the normal monitoring mode, press the LIMITS softkey. The current alarm limits display.

1. Press the SELECT softkey until highlighting the SPD sensitivity setting. The default setting of one (1) is the most sensitive to patterns of desaturation, but may also lead to more alarms.

Figure 42. SPD Sensitivity Setting

POX_10024_A

2. Use the ADJUST UP key to select a setting that is less sensitive to desaturation patterns, that also results in fewer alarms. The setting of three (3) is the least sensitive to patterns of desaturation.
3. Press the EXIT softkey to save your selection.

Using the Pulse Rate Delay Alarm Management Feature

How the Pulse Rate Delay Feature Works

The oximeter monitors pulse rate by determining the number of pleth waves over unit time. With traditional alarm management, upper and lower alarm limits are set for monitoring pulse rate. When the pulse rate fluctuates near an alarm limit, the alarm sounds each time it violates an alarm limit. Use the Pulse Rate Delay feature to distinguish clinically significant events from minor and brief pulse rate limit violations that result in nuisance alarms. The Pulse Rate Delay feature allows a period of threshold violation before the pulse rate alarm sounds. Thus, the Pulse Rate Delay feature distinguishes clinically significant events from minor and brief pulse rate limit violations that may result in nuisance alarms.

To use the Pulse Rate Delay feature, set the traditional alarm management upper and lower pulse rate alarm limits. Then, set the Pulse Rate Delay. The Pulse Rate Delay limit controls the time the pulse rate level crosses either limit before an audible alarm sounds.

To set the alarm delay

1. With the oximeter in the normal monitoring mode, press the LIMITS softkey.
2. Press SELECT softkey until highlighting the alarm delay setting, highlighting the default setting of OFF.
3. Use the ADJUST UP key to select a five (5) second alarm delay or a ten (10) second alarm delay.

4. Press the EXIT softkey to save your selection.

Figure 43. Pulse Rate Delay Setting

Using the SatSeconds™ Alarm Management Feature

How the SatSeconds Feature Works

The oximeter monitors the percentage of hemoglobin binding sites saturated with oxygen in the blood. With traditional alarm management, upper and lower alarm limits are set to alarm at specific SpO_2 levels. When the SpO_2 level fluctuates near an alarm limit, the alarm sounds each time it violates the alarm threshold. SatSeconds monitors both degree and duration of desaturation as an index of desaturation severity. Thus, the SatSeconds feature helps distinguish clinically significant events from minor and brief %SpO_2 limit desaturations that may result in nuisance alarms. See *First SpO2 Event: No SatSeconds Alarm,* Figure 5 on page 20, *Second SpO2 Event: No SatSeconds Alarm,* Figure 6 on page 21, and *Third SpO2 Event: Triggers SatSeconds Alarm,* Figure 7 on page 22.

Set upper and lower alarm limits using traditional alarm management methods. Then, use SatSeconds alarm management to defer the audible alarm for the specified period, even if the SpO_2 is below the selected lower alarm limit.

Saturation levels may fluctuate, rather than remain steady, for a period of several seconds. Often, the SpO_2 levels fluctuate above and below the alarm limit, reentering the non-alarm range several times.

During such fluctuations, the oximeter integrates the number of SpO_2 points, both positive and negative, until either the SatSeconds limit (SatSeconds time setting) is reached, or the SpO_2 level returns to within a normal range and remains there.

SatSeconds “Safety Net”

The SatSeconds “Safety Net” is for patients with saturation levels frequently below the limit, but not staying below the limit long enough for the SatSeconds time setting to be reached. When three or more limit violations occur within 60 seconds, an alarm sounds even if the SatSeconds time setting has not been reached.

SatSeconds Icon

When the SatSeconds technology detects an SpO2 value outside the alarm limit, the SatSeconds circle icon begins to "fill" clockwise. When the SpO2 value is within the set limits, the SatSeconds icon empties counterclockwise.

Figure 44. SatSeconds Icon and Alarm Limit Value

When the SatSeconds icon completely fills, indicating the threshold has been reached, an audible alarm sounds, the TREND softkey flashes, and the displayed SpO2 rate flashes. The TREND softkey continues to flash until the caregiver presses the TREND softkey to review the trend data. As with traditional alarm management, the audible alarm may be silenced by pressing the ALARM SILENCE key.

When SatSeconds is set to OFF, the SatSeconds icon does not appear on the screen. %SpO2 limit violations still cause TREND to flash until the caregiver presses the TREND softkey to review the trend data. The oximeter indicates SatSeconds or %SpO2 limit violations with small, filled circles above the trend line in the %SpO2 (SpO2 option) view of the trend data.

To set SatSeconds alarm limit

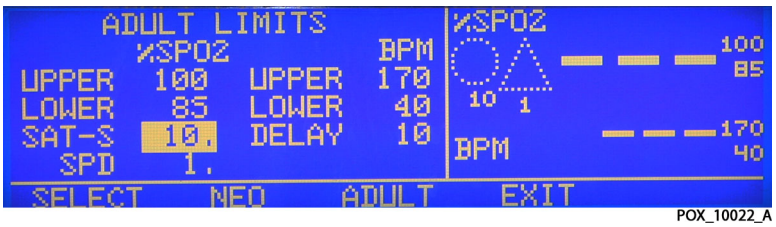
To adjust the SatSeconds limit, select the adult or neonate alarm limit display.

Note:

The ability to adjust the SatSeconds Alarm limit default settings can be enabled or disabled by qualified service personnel as described in the *N-600x Service Manual*.

1. With the oximeter in the normal monitoring mode, press the LIMITS softkey. The current alarm limits display.
2. Press the SELECT softkey twice to select %SpO2 SAT-S.

Figure 45. Setting the SatSeconds Alarm Limit



3. Use the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to select the limit. The choices are 10, 25, 50, 100 SatSeconds or OFF. A decimal to the lower right indicates it is not a default setting.
4. Press the EXIT softkey to save your selection.

5 Managing Oximetry Data

Managing Oximeter Trend Data

Trend Data Basics

The OxiMax N-600x™ pulse oximeter records trend data. Two types of trend data can be viewed using the trend display option.

- Oximeter trend data stored in the oximeter
- Patient event data stored in the OxiMax™ pulse oximetry sensor (single-patient-use sensors only) and can be used with the sensor event record feature.

Oximeter trend data can be viewed anytime patient trend is stored in the oximeter. Access oximeter trend data by pressing the TREND softkey on the main menu and selecting the MONITR softkey option. The TREND submenu provides multiple methods of displaying trend data.

- Dual trend data display (both saturation and pulse rate)
- SpO2 (Saturation) trend data display
- Pulse rate (BPM) trend data display
- Pulse amplitude trend data display
- Histogram trend data display

The oximeter can graphically display trend data for SpO2, pulse rate, or both. Trend data is stored at one-second intervals. When the TREND softkey is pressed, "READING TRENDS" displays at the bottom of the oximeter screen, indicating that the oximeter is formatting the trend data to be displayed.

The oximeter stores up to 45 hours of trend data. The amount of trend data displayed on the screen is determined by using the ZOOM softkey. View trend data information for any number of time spans. Settings available are 20 and 40 seconds, 15 or 30 minutes, and one, two, four, eight, 12, 24, 36, or 48 hours. All trend data are displayed in a graphical format except the 20 and 40 second trend displays, which are shown in tabular format.

Trend data is further explained in *Product Specifications*, page 127.

Retrieve trend data information through the oximeter data port or clear it using the appropriate display menu option.

Note:

Oximeter trend data will be lost if the main battery fails or is removed.

Reading the Trend Data Display

Figure 45. Identifying the components of the trend data display

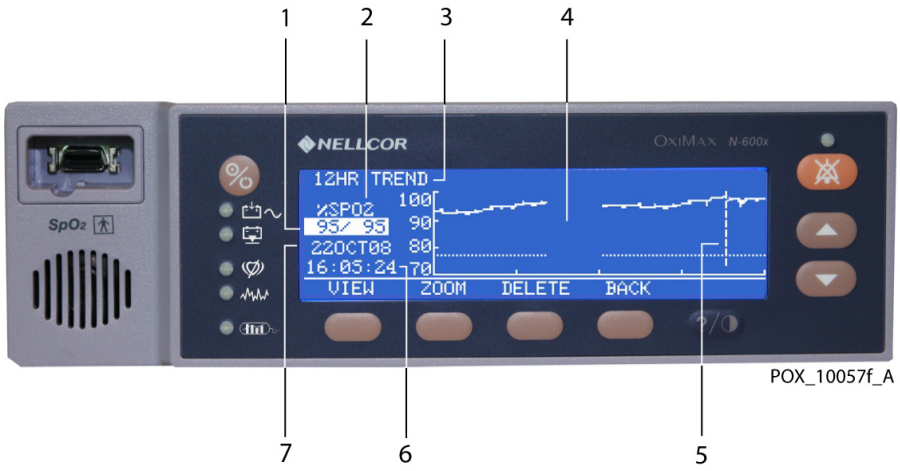


Table 8. Trend Data Display Components

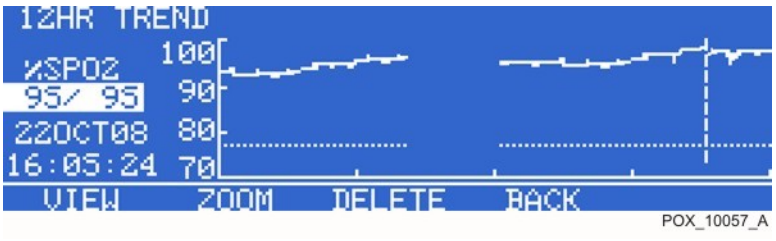
1	Highest and lowest reading at the cursor position.
2	Trend data that is being displayed (%SpO2, BPM, or PAU [pulse amplitude units]).
3	Amount of trend data displayed on the screen. Settings available are 20 and 40 seconds, 15 and 30 minutes, 1, 2, 4, 8, 12, 24, 36, and 48 hours.
4	No trend data recorded during this time.
5	Cursor can be moved left or right using the ADJUST UP (right) or ADJUST DOWN (left) keys.
6	Time represented by the cursor (item 5).
7	Date represented by the cursor (item 5).

View the trend display at any time. Selecting the one-hour trend display allows you to view one hour of trend information. By using the scrolling feature, any single hour of trend data can be viewed up to a maximum of 45 hours of trend information. The ADJUST DOWN key below the ALARM SILENCE key scrolls the display to the left and the ADJUST UP key below the ALARM SILENCE key scrolls the display to the right.

When the data displays, the most recent readings are on the right side of the graph. The numbers below %SpO2 indicate the highest and lowest parameter values at the

cursor position (vertical dotted line on the display). See *Reading the Trend Data Display*, page 68.

Figure 46. %SpO2 Trend Data Screen, 12 hour trend



To view dual trend data display

The dual trend data display shows both oxygen saturation (%SpO2) levels and pulse rate (BPM) trend data.

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press the DUAL softkey. The dual trend (%SpO2 and Pulse Rate) displays.

Figure 47. Dual Trend Data Display Screen, 12 hour trend

To view SpO2 trend display

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press the SpO2 softkey. %SpO2 trend data displays.

Figure 48. SpO2 Trend Data Display Screen, 12 hour trend

To view pulse rate trend display

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press the PULSE softkey. The pulse rate trend data displays.

Figure 49. BPM Pulse Trend Data Display Screen, 1 hour trend

To view pulse amplitude trend data display

The pulse amplitude trend data display shows the amplitude of the patient's pulse rate over the period of time indicated on the display. Refer *To select the trend data display scale*, page 71 to setup the desired trend data scale.

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press the NEXT softkey.
5. Press the AMP softkey. The pulse amplitude units (PAU) trend data displays.

Figure 50. Pulse Amplitude Trend Data Display Screen, 1 hour trend

The PAU reading (16 : 16) indicates the pulse amplitude units (upper and lower) at the cursor position (dashed line). The cursor moves right or left using the ADJUST UP (right) and ADJUST DOWN (left) keys.

To view histogram trend data display

The histogram displays trend data for the percent of oxygen blood saturation (%SpO_2) and pulse rate (BPM). The data displayed represents the trend data stored over the period of time indicated on the display. Refer to *To select the trend data display scale*, page 71, to set up the desired trend data scale. Pulse amplitude cannot be displayed on the histogram display.

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press the NEXT softkey.
5. Press the HIST softkey. The histogram trend data displays.

Figure 51. Histogram Trend Data Display Screen, 12 hour history

Storing Trend Data

Whenever the oximeter is powered on, it stores the SpO2 and pulse rate readings in memory every second, regardless of whether the oximeter is in use monitoring a patient or not. The oximeter can store up to 45 hours of trend data. If desired, download the 45 hours of stored trend data to a printer or a portable computer. Up to 50 alarm limit changes can be stored in the trend data. If more than 50 alarm limit changes occur during the 45 hours of trend data collection, the additional alarm limit changes will take space reserved for trend data.

Caution

Changing alarm limit settings uses up trend memory space. Change alarm limits only as needed.

Note:

Trend memory always contains the most recent 45 hours of data, with newly collected data overwriting the oldest data on a rolling basis. The oximeter continues to record data points as long as it is powered on, with "blank" data points collected if no OxiMax pulse oximetry sensor is connected to the oximeter or patient. "Blank" data overwrites older patient data if the memory is full. To save old patient data, turn the oximeter off when not monitoring a patient and download the trend memory before it fills up, overwriting the old data with new data (or "blank" data).

To select the trend data display scale

The trend scale is the amount of trend data displayed on the screen.

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.
3. Press the VIEW softkey.
4. Press any of the trend softkeys (DUAL, SpO2, or PULSE). To select HIST (histogram) or AMP (amplitude), press the NEXT softkey and then the HIST or AMP softkeys.
5. Press the ZOOM softkey. The Zoom menu displays.

6. Press the TIME softkey to cycle the displayed trend time scale until you reach the desired interval. The TIME softkey cycles through 48, 36, 12, eight, four, two, and one hour intervals, then 30 minute, 15 minute, 40 second and 20 second intervals.

Figure 52. BPM Trend Data Screen, 1 hour trend

Note:

The 20-second and 40-second trend displays are in tabular format. The display below begins in the normal response mode (left side of the display) and switches to the fast response mode.

7. Press the SCALE softkey to select the desired trend amplitude scale. The SCALE softkey cycles the displayed trend amplitude scale through ±5 points, ±10 points, ±15 points, ±20 points, ±25 points, ±30 points, ±35 points, ±40 points and ±50 points above and below the data point under the cursor. The saturation graphical trend display vertical scale default setting is from 10 to 100 if there is no data under the cursor. The pulse rate graphical trend display vertical scale is from 5 to 250 if there is no data under the cursor.

Figure 53. Trend Data History, Scaled

8. Press the AUTO softkey to select the desired preset data point amplitude. The AUTO softkey presets the amplitude of the graphed trend data. The maximum trend data point value is rounded up to the nearest multiple of ten and displayed at the top of the graph. The minimum trend data point value is rounded down to the next multiple of ten, then another ten subtracted from the result and displayed at the bottom of the graph.
9. Press the BACK softkey to return to the MONITR menu.

Clearing Trend Information

To clear trend data

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the MONITR softkey.

3. Press the DELETE softkey or press NO and then EXIT to close this function without deleting the trend data.

Note:
All the trend data clears after pressing the DELETE softkey and the oximeter sounds three beeps.

4. Press the YES softkey.

Managing OxiMax™ Pulse Oximetry Sensor Data

Understanding Sensor Messages

OxiMax pulse oximetry sensor messages display when the oximeter identifies a new sensor, or when the oximeter is unable to display saturation data.

Sensor Type Message

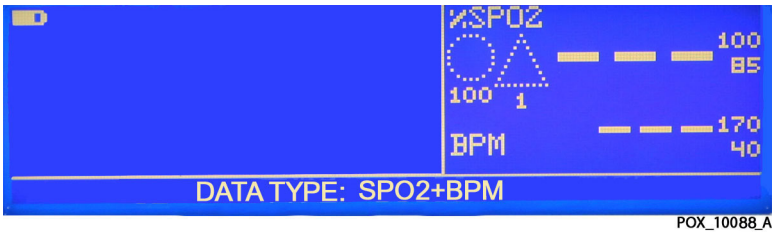
When an OxiMax pulse oximetry sensor is connected to the oximeter, a "SENSOR TYPE:..." message displays for four to six seconds at the bottom of the screen. The message identifies the type (model) of OxiMax pulse oximetry sensor connected to the oximeter.

Figure 54. Sensor Type Message Screen

In-Sensor Data Type Message

When an OxiMax pulse oximetry sensor with no previously recorded patient data is connected to the oximeter, a "DATA TYPE: . . ." message displays briefly at the bottom of the oximeter screen after the sensor type message. The message identifies the oximeter's current data type setting that will be used to write data to the OxiMax pulse oximetry sensor. The data type setting options are EVENT/SpO2 and EVENT/SpO2+BPM.

Figure 55. In-Sensor Data Type Message Screen



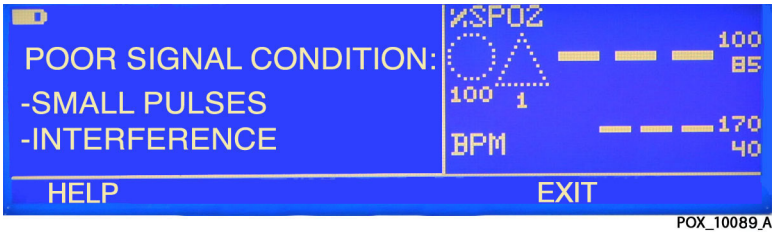
The sensor event record type must be set prior to connecting the OxiMax pulse oximetry sensor to the oximeter. To change the sensor data type setting, refer to *Managing the In-Sensor Data Type Feature*, page 77.

Sensor Condition Messages

Sensor condition messages indicate the sensor is functioning properly, but the sensor site or the application method is not optimal for calculating %SpO2.

Sensor condition messages appear in order of importance, with the highest level of priority at the top. Up to three condition messages may be displayed on the "POOR SIGNAL CONDITION" screen.

Figure 56. Poor Signal Condition Message Screen



Press the HELP key from the Condition message display for suggested corrective actions. The following list identifies possible sensor adjust condition messages.

- SENSOR OFF?
- SMALL PULSES
- WEAK SIGNAL
- INTERFERENCE
- EXCESS INFRARED LIGHT
- HIGH PULSE AMPLITUDE

Sensor Corrective Action Messages

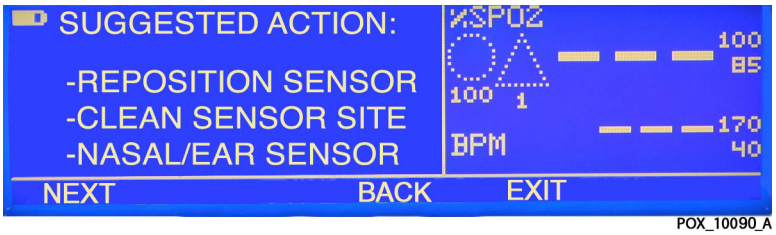
Corrective action messages are linked to the type of OxiMax pulse oximetry sensor connected to the oximeter. Up to five corrective action messages may be displayed. Multiple screens may be required to display all of the messages. When multiple screens are required, navigation between screens can be accomplished by using the NEXT, BACK, and EXIT softkeys. The following list includes possible corrective suggestions.

- ALTERNATE SITE?
- COVER SENSOR SITE?
- EAR/FOREHEAD SENSOR?
- NASAL/EAR SENSOR?
- OXIMAX ADHESIVE SENSOR
- SECURE CABLE
- HEADBAND
- WARM SITE

- BANDAGE ASSEMBLY
- NAIL POLISH
- SENSOR TOO TIGHT?
- REPOSITION SENSOR
- ISOLATE INTERFERENCE SOURCE
- CLEAN SENSOR SITE

To clear messages, review the listed corrective actions and take appropriate steps to clear the condition, then press the EXIT softkey. Once closed, the sensor message screen will not return until a new condition occurs.

Figure 57. Corrective Action Screen

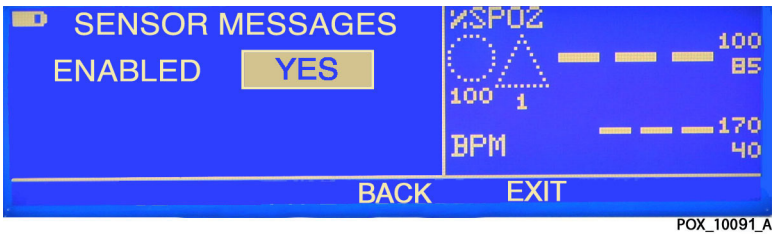


Enabling or Disabling the Sensor Message Feature

The OxiMax pulse oximetry sensor message setup display allows you to enable or disable the sensor message feature. When disabled, neither the “SENSOR NOT POSTING” nor the “SUGGESTED ACTION” messages display.

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the SENSOR softkey.
3. Press the MSG softkey.

Figure 58. Enable Sensor Message Screen



4. Press the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter to toggle the ENABLE message.
5. Press the EXIT softkey.

Using Sensor Event Records

Sensor Event Record Overview

WARNING

The pulse oximetry sensor extrapolates from the date and time provided by the Nellcor OxiMax N-600x pulse oximeter when recording the sensor event record to the sensor. The accuracy of the date/time is determined by the date/time setting of the pulse oximeter. Set the pulse oximeter date and time to the correct value before connecting a record-enabled sensor to keep the date and time consistent for as long as the sensor remains connected. Since a sensor with sensor event record data can be transported from one oximeter to another, having discrepancies in the date/time between oximeters and the sensor event record data will affect the order in which the sensor event record data appear. To eliminate this potential problem, set all oximeters within an institution to the same time.

In-Sensor Data

OxiMax adhesive pulse oximetry sensors are capable of storing patient alarm event data. A sensor event record allows alarm event history to travel with the patient on the sensor's memory chip for quick assessment at every point of care where OxiMax oximeters are used.

Patient (alarm event) data is stored on the memory chip of OxiMax adhesive pulse oximetry sensors (single-patient-use sensors only). The alarm event data is stored (recorded) with the limit/threshold settings that were active at the time of the event on the recording oximeter. These events can be viewed on the next OxiMax oximeter when the patient moves to a new point of care.

Sensor Event Records

An event occurs when the %SpO_2 value exceeds either the upper or lower alarm limit for at least 15 seconds. Alarm events are grouped and recorded to the memory chip every five minutes. The maximum number of events that can be stored in an OxiMax pulse oximetry sensor is typically 100.

Event records can only be viewed after an OxiMax pulse oximetry sensor containing patient alarm data (event records) has been connected to an OxiMax N-600x pulse oximeter with SENSOR enabled. Event records are designed to view patient events from prior areas of care or transport (history) while oximeter trend should be used to view data or events from a patient currently being monitored.

The oximeter's SENSOR EVENT RECORD indicator lights when an OxiMax pulse oximetry sensor containing event data is connected to the oximeter.

Recording and viewing of sensor event record is only available on OxiMax-compatible monitors with SENSOR enabled. The OxiMax sensors may function on older technology monitors but the sensor event record feature is not available.

Refer to the *N-600x Service Manual* for specific instruction on how to disable the storage of the sensor event recorded in an OxiMax pulse oximetry sensor.

Managing the In-Sensor Data Type Feature

The In-Sensor Data Type display enables you to adjust the type of patient alarm event trend data to be recorded in an OxiMax pulse oximetry sensor. OxiMax pulse oximetry sensors can be set to record either "SpO2" or "SpO2+BPM."

Note:

The OxiMax pulse oximetry sensor data type can only be set when the sensor is not connected to the oximeter.

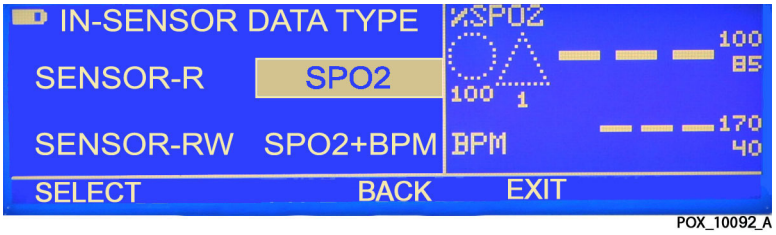
To select sensor data type

1. With the oximeter turned on and no cables attached to the SpO2 OxiMax sensor port, press the SETUP softkey.
2. Press the SENSOR softkey.
3. Press the DATA softkey.

Note:

OxiMax sensor data type settings are displayed on the oximeter screen. If no sensor is connected, both sensor types and the full set of options for each are displayed. If a sensor is connected, only the sensor data type for that sensor displays.

Figure 59. Identifying In-Sensor Data Type Screen



4. Use the SELECT softkey to toggle between SENSOR-R (sensor contains read-only chip) and SENSOR-RW (sensor contains a read/write chip).

Note:

The SENSOR-R feature supports all the current OxiMax pulse oximetry sensors. The SENSOR-RW feature is only applicable to OxiMax pulse oximetry sensors with a read/write chip installed.

Use the ADJUST UP or ADJUST DOWN key below the ALARM SILENCE key on the oximeter to select the sensor data type. SENSOR-R and SENSOR-RW selections are:

- SPO2
- SPO2+BPM
- DEFAULT

1. Press the EXIT softkey to set the sensor data type.

To view sensor event record

Access patient alarm event data with the patient sensor attached to the oximeter.

1. Press the TREND softkey from the main menu.

2. Select the SENSOR softkey option.
3. View sensor event record in either the graphical form (GRAPH) or in a summary table (TABLE).

Note:

Once the sensor event record type is setup in the OxiMax pulse oximetry sensor and the event data is stored in the sensor, the sensor event record type cannot be reset. The oximeter's type set up can be changed at any time.

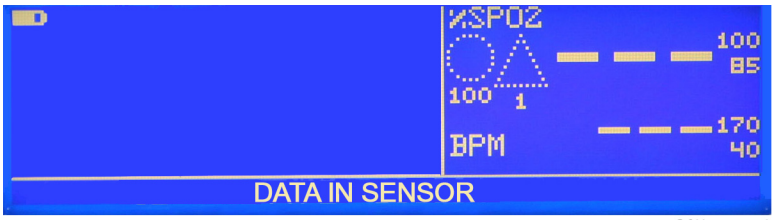
Managing Non-graphical Sensor Event Record Data

When an OxiMax pulse oximetry sensor containing patient alarm data (single-patient-use sensors only) is connected to the oximeter, the Sensor Event Record indicator on the oximeter front panel blinks at a medium priority flash rate to indicate that the OxiMax pulse oximetry sensor attached to the oximeter contains patient event data. The front panel blinks for approximately 60 seconds, until the OxiMax pulse oximetry sensor is disconnected, or until the user obtains sensor trend data by pressing TREND, then SENSOR.

To obtain available Sensor Event Record data

1. Press the TREND softkey.
2. Press the SENSOR softkey. A corresponding "DATA IN SENSOR" message displays at the bottom of the oximeter screen. After four to six seconds, if the oximeter successfully reads all the data from the sensor, the oximeter returns to the main menu.

Figure 60. Data In Sensor Screen



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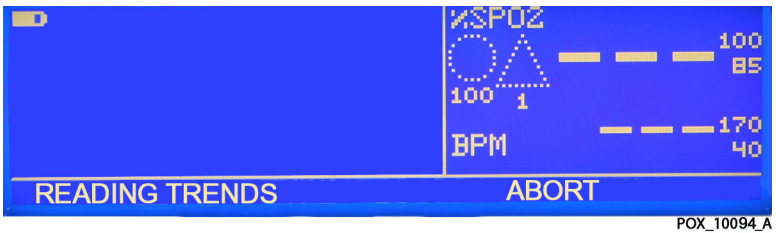
If data is still being read from the OxiMax pulse oximetry sensor after four to six seconds, the DATA IN SENSOR message is replaced with a READING TRENDS message which includes an ABORT option.

Figure 61. Reading Trends from Data In Sensor Screen



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3. Select the ABORT softkey to stop the recording or to access or view additional data. View sensor event records by accessing the TREND/SENSOR menu.

   The SENSOR EVENT RECORD LED comes on steady when sensor memory is full and stays on until the OxiMax pulse oximetry sensor is disconnected.

Note:

If the sensor does not contain any data or if no events were recorded to the sensor memory chip in the prior monitoring situation, the TREND/SENSOR option is not available. A sample event display without data is shown below. The message clears when the graph or summary closes.

Figure 62. Sensor Event Graphical History Screen, No Data

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Managing Graphical Sensor Event Record Data

Graphical representations of patient event history are only available on single-patient-use OxiMax pulse oximetry sensors. Graphed data points are the minimum or maximum %SpO2 value for each 30-second interval throughout the duration of an event (%SpO2 continuously below alarm threshold for at least 15 seconds) and continuing every 30 seconds until the actual %SpO2 value equals or exceeds the alarm threshold.

The duration of an event is determined by the number of data points in the event. Each data point is stored at 30-second intervals.

Events end due to one of the following reasons:

- %SpO2 returns to or above the alarm limit
- Loss of pulse
- OxiMax pulse oximetry sensor is disconnected
- OxiMax pulse oximetry sensor is removed from the patient

Figure 63. Sensor Event Graphical History Screen, Page 2 of 2

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The graph title shows the data type (GRAPH) in the upper left corner. The number of the displayed event and the total number of events recorded in the OxiMax pulse

oximetry sensor are shown to the right of the title (example, 2/2). The date and time of the displayed event are shown in the upper center and upper right corner.

The type of data displayed in the graph is indicated to the left of the vertical axis (%SpO2). Below this is the range of values (min./max.) during the event. The duration of the event is shown below the range value. The vertical axis of the graph is labeled to show the magnitude scale of the graphed data. The horizontal axis is not labeled but automatically scales to accommodate the number of 30-second intervals during the event. The alarm threshold (lower than SpO2 alarm limit) is represented by a horizontal dotted line across the graph. The first data point is the alarm threshold.

Events are displayed one at a time and one per graph. Graphs are displayed in chronological sequence, with the most recent event shown first when accessing the graphical sensor event display. The user can move between events by using the two left-most softkeys which are labeled with left- and right-facing arrow icons, respectively. At the beginning of an event sequence, event one of two events, the left arrow softkey is blank; at the end of a sequence, event two of two events, the right arrow softkey is blank.

The ADJUST UP and ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel can also be used to move through events.

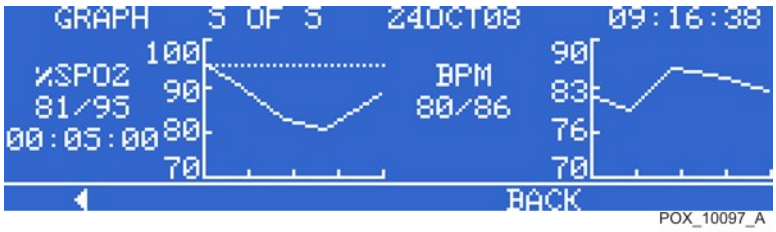
The BACK softkey returns to the previous TREND/SENSOR submenu level.

To view Sensor Event History data

With the oximeter in the normal monitoring mode, you can view sensor event history data.

1. Connect an OxiMax pulse oximetry sensor containing patient data to the oximeter's SpO2 sensor port and cable.
2. Press the TREND softkey.
3. Press the SENSOR softkey.
4. Press the GRAPH softkey.

Figure 64. Sensor Event Graphical History Screen, Page 5



Note:
Use the left and right arrow softkeys to scroll through the pages of the event graph.

5. Press the EXIT softkey.

   A sequence of %SpO2 + BPM (saturation plus pulse rate) dual-view event graphs are shown below. The dual-view graph is the same as a single graphical event

history graphs, except the graphs are compressed horizontally to allow both %SpO2 and pulse rate graphs to be shown for the same event.

Figure 65. Sensor Event Graphical History Screen: Screen 1of 5

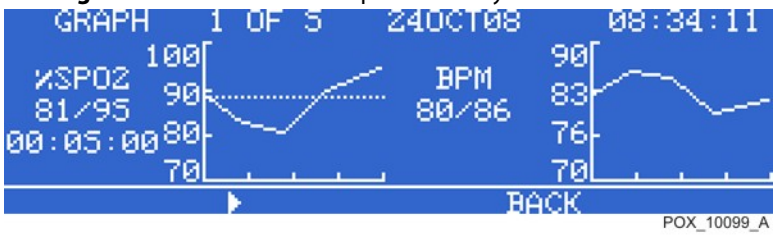


Figure 66. Sensor Event Graphical History Screen: Screen 4 of 5

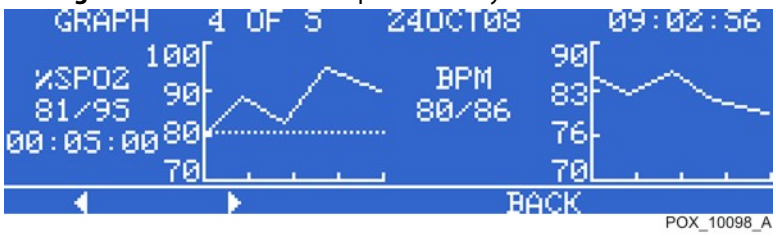
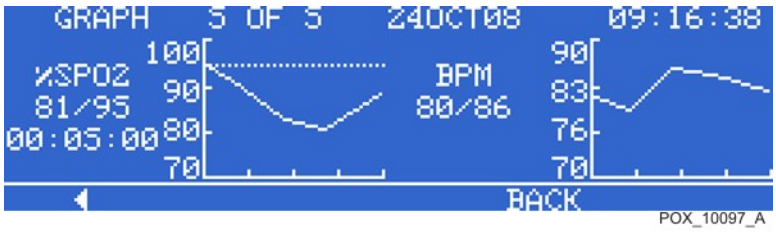


Figure 67. Sensor Event Graphical History Screen: Screen 5 of 5



To view and print in-sensor Tabular Event data

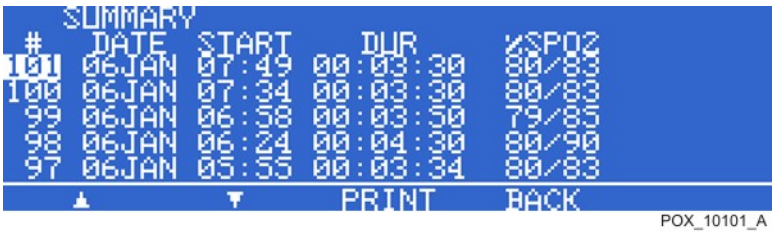
The sensor tabular event data is a listing of all events recorded on the OxiMax pulse oximetry sensor's memory chip.

1. With the oximeter in the normal monitoring mode, press the TREND softkey.
2. Press the SENSOR softkey.

3. Press the TABLE softkey to view the data.

Figure 68. History Summary Data Screen: January 02

Figure 69. History Summary Data Screen: January 06



The table title is located in the upper left corner. Below the table title is a six-column table with appropriate column headings. Event data appear in chronological order with the most recent event shown first, at the top of the list.

Four events can be displayed simultaneously. To view additional events, continue scrolling by using the appropriate softkey below the up and down arrow icons. Each screen view retains the last event screen from the previous page and displays the next three events. Up or down arrow icons only appear if scrolling up or down is an option. If an arrow icon is blank, this indicates the beginning or end of the table.

4. Use the ADJUST UP and ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to move through the Event Summary table line by line.
5. Use the PRINT softkey to print the displayed event data.
6. Return to the previous TREND/SENSOR submenu level using the BACK softkey.

To view or print in-sensor Tabular Event History data

1. Refer to *Printing Oximeter Trend Data*, page 86, for configuring the data port and printer.
2. With the oximeter in the normal monitoring mode, press the TREND softkey.
3. Press the SENSOR softkey.
4. Press the TABLE softkey to view the data. Press the PRINT softkey to print the data.
5. Press the BACK softkey.

Data Port Connectivity

Overview

Patient data can be output through the data port on the back of the OxiMax N-600x pulse oximeter by connecting it to a PC or serial printer.

When connecting the oximeter to a printer or PC, verify proper operation prior to clinical use. Both the oximeter and the printer or PC must be connected to a grounded AC power outlet. The oximeter protocol setting must be ASCII.

Any printer or PC connected to the oximeter's data port must be certified according to IEC Standard 60950-1: 2nd edition. All combinations of equipment must be in compliance with IEC Standard 60601-1-1: 2000 Requirements for Medical Electrical Systems. Anyone who connects a printer or PC to the data output port configures a medical system and is therefore responsible for ensuring the system complies with Requirements for Medical Electrical Systems IEC Standard 60601-1-1: 2000 and the electromagnetic compatibility IEC Standard 60601-1-2: 2001 + A1: 2004.

Data Port Requirements

The data port may be connected to a serial printer or PC by using a cable terminated with the following devices.

- An AMP connector (AMP part number 747538-1)
- A ferrule (AMP part number 1-747579-2)
- Compatible pins (AMP part number 66570-2)

The cable should not exceed 25 feet (7.6 meters) in length using RS-232 protocol or 4,000 feet (1219.2 meters) in length using RS-422 protocol. The external ITE (Information Technology Equipment) device must be certified to UL Standard 60950-1: 2007 or IEC Standard 60950-1: 2nd edition. The cable used must have a braided shield that provides 100% coverage, such as a Belden cable (Belden part number 9609 or 9616) or equivalent. The shield must have a 360-degree connection to the metal shell on the DB-15 connector and to the connector on the PC or serial printer.

Caution

Do not create sharp bends in the cable, as this may tear or break the shielding.

No hardware flow control is used. However, support exists for XON/XOFF flow control in ASCII mode.

Data Port Pinouts

WARNING

If the serial port, analog outputs, or nurse call lines are shorted, remote communication may be lost.

- **RS-232 Format**—Pins 2, 3, and 5 provide RS-232 format data When building an RS-232 cable, do not add a resistor and keep cable length to a maximum of 25 feet.

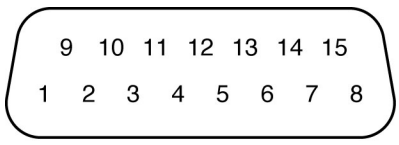
- **RS-422 Format**—Pins 1, 4, 9, and 12 provide RS-422 format data. When building an RS-422 cable, add a resistor (120 ohms, 1/2 watt, 5%) between pin 1 and pin 9 of the cable and keep cable length to a maximum of 4,000 feet. Plug the end of the cable with the resistor added into the oximeter.
- **Differential Data Transmission**—Pins 3 and 4 (TxD+ and TxD-) are the differential transmit data pair.
- **Differential Data Reception**—Pins 1 and 2 (RxD+ and RxD-) are the differential receive data pair.

Table 9. Data Port Signal Pinouts

Pin Number	Signal Name
1	RxD+ (RS-422 [+] input)
2	RxD_232 (RS-232 input)
3	TxD_(RS-232 output)
4	TxD+ (RS-422 [+] output)
5	Signal Ground (isolated from Earth Ground)
6	AN_SpO2 (analog saturation output)
7	NC_NO (relay closure nurse call, normally open)
8	NC_NC (relay closure nurse call, normally closed)
9	RxD- (RS_422 [-] input)
10	Signal Ground (isolated from Earth Ground)
11	Nurse Call (RS-232-level-output)
12	TxD- (RS-422 [-] output)
13	AN_PULSE (analog pulse rate output)
14	AN_PLETH (analog pleth waveform output)
15	NC_COM (relay closure nurse call, common lead)

Figure 70 illustrates the pin layouts as viewed from the rear panel. The conductive shell connects to earth ground when connected to a PC or printer.

Figure 70. Data Port Pin Layout



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Data Port Communications

To establish data port communication

1. Use the Serial Port Setup display to set the baud rate and the protocol of the data port on the OxiMax N-600x pulse oximeter.
2. With the oximeter in the normal monitoring mode, press the SETUP softkey.
3. Press the NEXT softkey twice and then press the COMM softkey.
4. Press the SELECT softkey.

Figure 71. Serial Port Setup Screen, Baud Rate Protocol Selection

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5. Press the ADJUST UP or ADJUST DOWN keys to select the desired protocol. Protocol options for the OxiMax N-600x pulse oximeter differ from those of the oximeter with the SPD feature activated. The factory default protocol is ASCII. See *Communication Protocol Compatibility and Output*, page 85.

Table 10. Communication Protocol Compatibility and Output

Communication Protocols	N-600x with Firmware up to 2.0 Default Baud Rate	N-600x with Firmware 2.0 and Above	
		Default Baud Rate	Output includes SPD data fields
ASCII	9600	9600	Yes[1]
CLINICAL	19200	19200	Yes
GRAPH (Graphics)	9600	N/A	No
OXINET	9600	N/A	No
PHILIPS (VueLink)	19200	19200 Use only 19200	No
SPACELBS (Spacelabs)	9600	N/A	No
MARQ (GE Marquette)	9600	N/A	No
DATEX (Datex-Ohmeda)	2400	N/A	No
SPDout	N/A	Default 115200 Available: 19200, 57600, 115200	Yes

[1] Not provided in real-time output

6. Press the SELECT softkey.

Note:
When SPD is enabled, the Clinical and SPDout protocols include SPD information. Results cannot be predicted for host systems without upgrades to support the extra SPD information. See Table 10: *Communication Protocol Compatibility and Output*, on page 85.

7. Press the ADJUST UP or ADJUST DOWN keys below the ALARM SILENCE key on the oximeter panel to select the desired baud rate, should it differ from the default for that particular protocol.
8. Press the EXIT softkey.

Data Output Information

Printing Oximeter Trend Data

Refer to the Service Manual or contact Nellcor's Technical Services Department at 1.800.635.5267, or your local Nellcor representative.

Real-Time Output

Real-time data is continuously sent to the data port on the back of the oximeter.

Patient data can be obtained through the data port by connecting the oximeter data port to a PC or serial printer. When real-time output is being transmitted to a printer or PC, a new line of data displays every second. Column headings display or print after every 25 lines, or if one of the values in the column heading changes. Readings display at one-second intervals.

Note:
If the data output stops transmitting, turn the power off and back on again or, if the oximeter is connected to a PC, send an XON (Ctrl-q) command to reset the oximeter.

Real-Time Output Data Fields

Here is an example of real-time data output.

Figure 72. Sample Real-Time Data Output (SPD feature not enabled)

```
N600x VERSION 2.0.4.0      CRC:0000      SpO2 Limit: 85-100% PR Limit: 40-170BPM
      ADULT 100SAT-S       SPO2 RESP MODE: NORMAL
TIME   %SPO2      BPM   PA     Status
27-OCT-08 13:41:57  90    60     5
27-OCT-08 13:41:59  90    60     5
27-OCT-08 13:42:01  90    60     5
27-OCT-08 13:42:03  90    60     5
27-OCT-08 13:42:05  90    60     5
27-OCT-08 13:42:07  90    60     5
27-OCT-08 13:42:09  90    60     5
27-OCT-08 13:42:11  90    60     5
27-OCT-08 13:42:13  90    60     5
27-OCT-08 13:42:15  90    60     5
27-OCT-08 13:42:17  90    60     5
27-OCT-08 13:42:19  90    60     5
27-OCT-08 13:42:21  100   190*   51            PH
27-OCT-08 13:42:23  100   190*   53            PH          LB
27-OCT-08 13:42:25  100   190*   50            PH          LB
27-OCT-08 13:42:27  100   090*   50            PH          LB
27-OCT-08 13:42:29  ---   ---    ---    SD                 LB
27-OCT-08 13:42:31  ---   ---    ---    SD                 LB
27-OCT-08 13:42:33  ---   ---    ---    SD
27-OCT-08 13:42:35  ---   ---    ---    SD
27-OCT-08 13:42:37  ---   ---    ---    SD
27-OCT-08 13:42:39  ---   ---    ---    SD
N600x VERSION 2.0.4.0      CRC:0000      SpO2 Limit: 85-100% PR Limit: 40-170BPM
      ADULT 100SAT-S       SPO2 RESP MODE: NORMAL
TIME   %SPO2      BPM   PA     Status
27-OCT-08 13:42:41  90    60     5
N600x VERSION 2.0.4.0      CRC:0000      SpO2 Limit: 80-100% PR Limit: 40-170BPM
      ADULT 100SAT-S       SPO2 RESP MODE: NORMAL
TIME   %SPO2      BPM   PA     Status
27-OCT-08 13:42:43  90    60     5
27-OCT-08 13:42:45  90    60     5
```

POX_10066_A

1. **Column Headings**—Every 25th line of the data output consists of a column heading. A column heading appears whenever the value within a column heading changes. The example above shows three distinct column heading sets. Starting at the top row, there are 25 lines before the second row of column headings print. The third row of column headings in Figure 72 appear when the operator changes the SpO2 lower alarm limit from 85 percent to 80 percent.

Figure 73. Sample Standard Column Headings

```
N600x VERSION 2.0.4.0      CRC:0000      SpO2 Limit: 85-100% PR Limit: 40-170BPM
      ADULT 100SAT-S       SPO2 RESP MODE: NORMAL
TIME   %SPO2      BPM   PA     Status
```

POX_10061_A

2. **Data Source**—Data in the highlighted box represents the model number of the oximeter, in this case the OxiMax N-600x pulse oximeter.

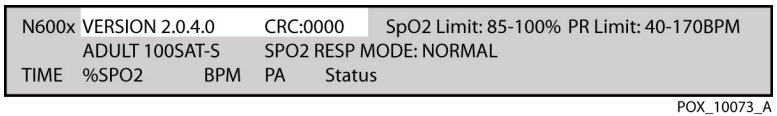
Figure 74. Location of Model Number in Column Headings

```
N600x VERSION 2.0.4.0      CRC:0000      SpO2 Limit: 85-100% PR Limit: 40-170BPM
      ADULT 100SAT-S       SPO2 RESP MODE: NORMAL
TIME   %SPO2      BPM   PA     Status
```

POX_10064_A

3. **Firmware Version**—The next data field displays the firmware level (Version 2.0.4.0) and a firmware verification number (CRC: XXXX). Neither of these numbers should change during normal operation.

Figure 75. Location of Firmware Version in Column Headings

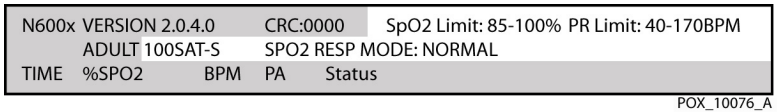

N600x VERSION 2.0.4.0 CRC:0000 SpO2 Limit: 85-100% PR Limit: 40-170BPM
ADULT 100SAT-S SPO2 RESP MODE: NORMAL
TIME %SPO2 BPM PA Status
POX_10073_A

Note:

The numbers may change if the oximeter is serviced and receives a firmware upgrade.

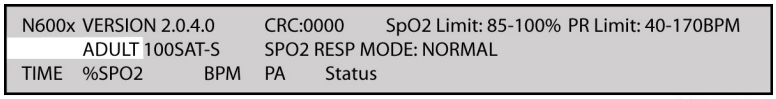
4. **Alarm Limits**—The last data field in the top line indicates the upper and the lower alarm limits for SpO2 and for the pulse rate (PR limit). In the example, the lower alarm limit for SpO2 is 85% and the upper alarm limit is 100%. Pulse Rate alarm limits are 40 and 170 BPM. The SatSeconds alarm limit (100SAT-S) displays the SatSeconds alarm setting. In this example, SatSeconds is set to 100.

Figure 76. Location of Alarm Limits in Column Headings


N600x VERSION 2.0.4.0 CRC:0000 SpO2 Limit: 85-100% PR Limit: 40-170BPM
ADULT 100SAT-S SPO2 RESP MODE: NORMAL
TIME %SPO2 BPM PA Status
POX_10076_A

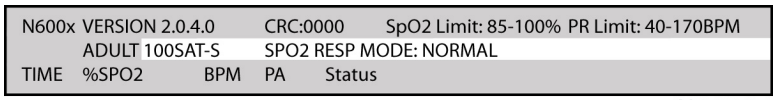
5. **Monitor Mode**—The first field of the second line identifies the monitor (ADULT or NEONATE) mode.

Figure 77. Location of Monitor Mode in Column Headings


N600x VERSION 2.0.4.0 CRC:0000 SpO2 Limit: 85-100% PR Limit: 40-170BPM
ADULT 100SAT-S SPO2 RESP MODE: NORMAL
TIME %SPO2 BPM PA Status
POX_10072_A

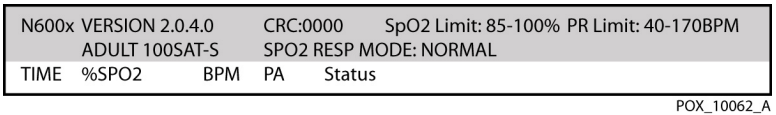
6. **Response Mode**—The second field of the second line identifies the SatSeconds alarm limit and SpO2 response (NORMAL or FAST) mode. The response mode may impact the SPD alarm behavior.

Figure 78. Location of SpO2 and Response Mode in Column Headings


N600x VERSION 2.0.4.0 CRC:0000 SpO2 Limit: 85-100% PR Limit: 40-170BPM
ADULT 100SAT-S SPO2 RESP MODE: NORMAL
TIME %SPO2 BPM PA Status
POX_10074_A

7. **Data Column Headings**—Actual column headings are in the last row of the column heading line.

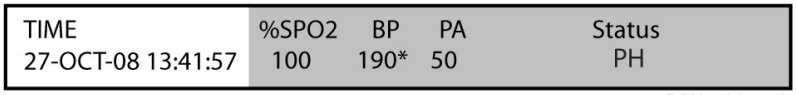
Figure 79. Location of Data Column Headings


N600x VERSION 2.0.4.0 CRC:0000 SpO2 Limit: 85-100% PR Limit: 40-170BPM
ADULT 100SAT-S SPO2 RESP MODE: NORMAL
TIME %SPO2 BPM PA Status
POX_10062_A

8. **Patient data**—Presented in the chart from left to right.
   - Time the patient data was recorded
   - Current %SpO_2 value
   - Current Pulse Rate (BPM)
   - Current Pulse Amplitude (PA)
   - Operating status of the oximeter

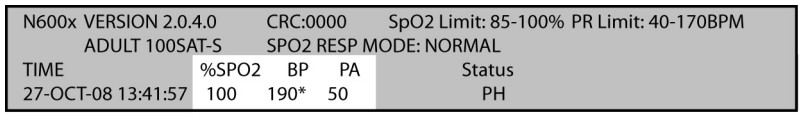
a. **Time**—The Time column displays the value of the real-time clock.

Figure 80. Location of Time Stamp



b. **Patient Data**—Parameter values display directly beneath the heading for each parameter. In this example, the %SpO2 is 100 and the pulse rate is 190 beats per minute. The "*" next to the 190 indicates that 190 beats per minute is outside of the alarm limits, indicated in the top row, for pulse rate. If no data for a parameter is available, three dashes [- - -] display. PA represents the pulse amplitude value, in which the number can range from 0 to 254. There are no alarm parameters for this value. It can be used for trending information as an indication of a change in pulse volume, relative pulse strength, or circulation.

Figure 81. Location of Patient Data



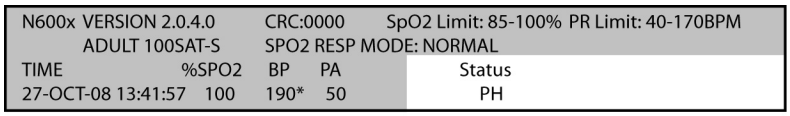
POX_10060_A

Note:

A sensor disconnect causes three dashes [- - -] to be displayed in the patient data section of the display or printout.

c. **Operating Status**—The Status column indicates alarm conditions and operating status of the oximeter. In this example, "PH" (Pulse High) indicates the pulse rate upper alarm limit has been exceeded. As many as four codes can be displayed at one time in the Status column.

Figure 82. Location of Operating Status Data



POX_10068_A

Table 11. Status Code Definitions

Code	Definition
AO	Alarm Off
AS	Alarm Silence
BU	Battery in Use

Table 11. Status Code Definitions

Code	Definition
LB	Low Battery
LM	Loss of Pulse with Signal Artifact
LP	Loss of Pulse
ID	Signal Artifact Detected
MO	Signal Artifact
PH	Pulse Rate Upper Limit Alarm
PL	Pulse Rate Lower Limit Alarm
PS	Pulse Search
SH	Saturation Upper Limit Alarm
SL	Saturation Lower Limit Alarm
SD	Sensor Disconnect
SO	Sensor Off

Caution

Signal artifacts, secondary to a variety of external factors may compromise the presence or accuracy of the displayed oximeter values.

Using the Nurse Call Interface

Nurse Call Feature

WARNING

Do not use the nurse call feature as the primary source of alarm notification. The audible and visual alarms of the pulse oximeter, used in conjunction with clinical signs and symptoms, are the primary sources for notifying medical personnel that an alarm condition exists.

WARNING

The nurse call feature of the OxiMax N-600x pulse oximeter is operational when the oximeter is powered by AC power or battery power. However, the nurse call feature does not function when oximeter alarms are silenced.

The nurse call feature of the OxiMax N-600x pulse oximeter allows caregivers to remotely monitor patient alarms and works in conjunction with the nurse call system of your institution. Access this feature through data port pins 7, 8, 10, 11, or 15 as indicated in Figure 70 on page 84.

The oximeter provides two different types of nurse call interfaces: an RS-232 level and relay closure. The RS-232 level nurse call function operates when the oximeter is connected to AC power or on battery. The relay-based nurse call function is available when the oximeter is operating either on AC power or on battery power.

When enabled, audible alarms signal the remote location. If the audible alarm has been turned off or silenced, the nurse call function is also disabled.

Pin 11 on the data port is the RS-232 level nurse call signal and pin 5 or 10 is ground (See Figure 70 on page 84). With no alarm condition, the voltage between pins 10 and 11 are -5 VDC to -12 VDC, or +5V DC to +12 VDC, depending on the option chosen via the softkeys (either NORM+ or NORM-). With an audible alarm, the output between pins 5 and 11 will reverse polarity.

Pins 7 and 15 provide a relay that closes when an alarm is sounding on the oximeter. Pins 8 and 15 provide a relay that opens when an alarm is sounding. Pin 15 is common, pin 7 is normally open, and pin 8 is normally closed. See *Rating of Nurse Call Relay*, page 128 for ratings.

Table 12. Nurse Call Relay Pin States

Pin	No Alarm or Alarm Silenced	Audible Alarm	Oximeter Off
7 NO	Open	Closed	Closed
8 NC	Closed	Open	Open

Test the nurse call function prior to using it in your facility and whenever setting up the OxiMax N-600x pulse oximeter in a location that uses nurse call. If an attached OxiMax pulse oximetry sensor is not connected to a patient, the oximeter display reads zeros and the oximeter remains in the Pulse Search Mode for five seconds, then the oximeter displays three dashes [- - -] in the %SpO2 and pulse rate area of the screen. One way to test the nurse call function is to create an alarm condition (for example, sensor disconnect) and verify activation of your facility's nurse call system.

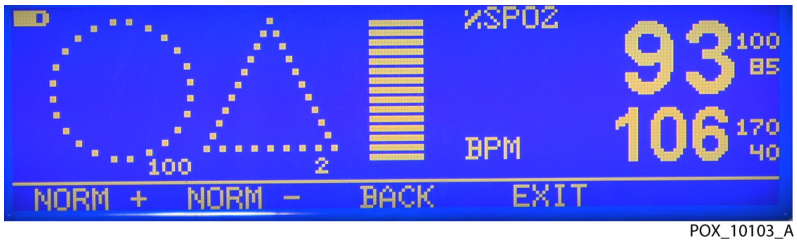
Setting Nurse Call RS-232 Polarity

The nurse call polarity can be set to a positive signal (NORM +) on a oximeter alarm condition or a negative signal (NORM -) on a oximeter alarm condition.

To set nurse call polarity

1. With the oximeter in the normal monitoring mode, press the SETUP softkey.
2. Press the NEXT softkey twice and then press the NCALL softkey.

Figure 83. Nurse Call Polarity Screen



POX_10103_A

3. Press the NORM + softkey OR press the NORM - softkey.
4. Press the EXIT softkey.

Calculating the Analog Voltage Output

The OxiMax N-600x pulse oximeter data port provides analog voltage outputs between pins 6, 13, 14, and ground (pin 10), which can be used to calibrate oximeters such as a chart recorder. The voltage represents a specific measured parameter's current value. The voltage differential varies proportionally from 0.0 to +1.0 VDC as the pin's parameter varies over its full range of values. For example, as the current value of SpO_2 varies from 0 to 100%, the voltage from pin 6 to ground (pin 10) varies from 0.0 to +1.0 VDC. A voltage of 0.94 volts indicates a current SpO_2 value of 94.

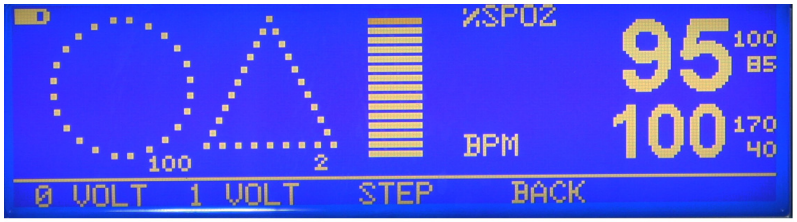
Table 13. Analog Pinouts

Pin	Parameter	Parameter Range
6	Saturation	0 - 100%
13	Pulse Rate	0 - 250 bpm
14	Waveform	0 - 254 PAU

To set analog voltage output

1. Press the SETUP softkey.
2. Press the NEXT softkey three times.
3. Press the ANALOG softkey.

Figure 84. Analog Voltage Screen



POX_10104_A

   a. **VOLT Options**—Selecting the 0 VOLT or 1 VOLT softkey causes that voltage to appear at pins 6, 13, or 14 as referenced to ground pins 5 and 10.

   b. **STEP Option**—Selecting the STEP softkey causes the voltage to increase from 0.0 to 1.0 volts at 1/10th-volt increments, with each step lasting at least one second.

4. Press the BACK softkey.

Have a qualified service technician perform the calibration of the attached device as described in the *N-600x Service Manual*.

6 Using OxiMax™ Pulse Oximetry Sensors and Accessories

Overview

WARNING

The pulse oximetry sensor extrapolates from the date and time provided by the Nellcor OxiMax N-600x pulse oximeter when recording the sensor event record to the sensor. The accuracy of the date/time is determined by the date/time setting of the pulse oximeter. Set the pulse oximeter date and time to the correct value before connecting a record-enabled sensor to keep the date and time consistent for as long as the sensor remains connected. Since a sensor with sensor event record data can be transported from one oximeter to another, having discrepancies in the date/time between oximeters and the sensor event record data will affect the order in which the sensor event record data appears. To eliminate this potential problem, set all oximeters within an institution to the same time.

The OxiMax N-600x™ pulse oximeter records a patient's sensor SpO_2 event history from the sensor's memory chip, allowing a patient's event history to travel with the patient as the patient moves throughout the hospital. This allows caregivers to track any patient events during transport or in the previous area of care. This feature is only available with adhesive single-patient-use OxiMax™ pulse oximetry sensors.

Caution

Single-patient-use sensors are intended for single-patient use only. Do not transfer an adhesive pulse oximetry sensor containing sensor trend data from one patient to a second patient. Doing so may result in data from the first patient being used to evaluate the second patient, since recorded SpO_2 event history data cannot distinguish among events collected from multiple patients.

OxiMax™ Pulse Oximetry Sensors

Selecting an OxiMax™ Pulse Oximetry Sensor

Before use, carefully read the OxiMax pulse oximetry sensor *Directions for Use*, including all warnings, cautions, and instructions.

WARNING

Use only Nellcor-approved OxiMax pulse oximetry sensors and pulse oximetry cables when connecting to the OxiMax sensor connector. Connecting any other cable or sensor influences the accuracy of sensor data, which may lead to adverse results.

WARNING

Do not use a damaged OxiMax pulse oximetry sensor or pulse oximetry cable. Do not use a sensor with exposed optical components.

WARNING

Do not attach any cable to the oximeter sensor port connector that is intended for computer use.

WARNING

Tissue damage can be caused by incorrect application or duration of use of an SpO2 OxiMax pulse oximetry sensor. Inspect the sensor site periodically as directed in the sensor *Directions for Use*.

WARNING

Do not lift the pulse oximeter by the pulse oximetry cable or power cord because the cable or cord could disconnect from the pulse oximeter, causing the pulse oximeter to drop on the patient.

WARNING

Pulse oximetry readings and pulse signal can be affected by certain ambient environmental conditions, sensor application errors, and certain patient conditions.

WARNING

Do not immerse or wet the OxiMax pulse oximetry sensor.

Caution

The sensor disconnect error message and associated alarm indicate that the sensor is either disconnected or the wiring is faulty. Check the sensor connection and, if necessary, replace the OxiMax pulse oximetry sensor, pulse oximetry cable, or both.

Caution

OxiMax adhesive pulse oximetry sensors are intended for single-patient use only. Do not transfer a sensor containing sensor trend data from one patient to a second patient. Doing so may result in data from the first patient being used to evaluate the second patient, since recorded SpO2 event history data cannot distinguish among events collected from multiple patients.

Note:

Physiological conditions, medical procedures, or external agents that may interfere with the pulse oximeter's ability to detect and display measurements include dysfunctional hemoglobin, arterial dyes, low perfusion, dark pigment, and externally applied coloring agents such as nail polish, dye, or pigmented cream.

Contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative for a Sensor Accuracy Grid listing all of the OxiMax pulse oximetry sensors used with the OxiMax N-600x pulse oximeter.

When selecting an OxiMax pulse oximetry sensor, consider the patient's weight and activity level, the adequacy of perfusion, and the available sensor sites, the need for sterility, and the anticipated duration of monitoring. For more information refer to *OxiMax™ Pulse Oximetry Sensor Models and Patient Sizes* or contact your local Nellcor representative. Refer to *OxiMax™ Pulse Oximetry Sensor Performance Considerations*, page 102, for more information on sensor performance.

Table 14. OxiMax™ Pulse Oximetry Sensor Models and Patient Sizes

OxiMax™ Pulse Oximetry Sensor	Model	Patient Size
Max-Fast™ forehead sensor	MAX-FAST®	>10 kg
OxiMax™ pulse oximetry sensor (Sterile, single-use only)	MAX-N MAX-I MAX-P MAX-A MAX-AL MAX-R	<3 or >40 kg 3 to 20 kg 10 to 50 kg >30 kg >30 kg >50 kg
Durasensor™ finger clip sensor (Reusable, nonsterile)	DS-100A	>40 kg
Oxiband™ reusable sensor (Reusable with adhesive nonsterile)	OXI-A/N OXI-P/I	<3 or >40 kg 3 to 40 kg
OxiCliq™ sensors (Sterile, single-use only)	P N I A	10 to 50 kg <3 or >40 kg 3 to 20 kg > 30 kg
Dura-Y™ multisite sensor (Reusable, nonsterile) For use with the Dura-Y sensor: Ear clip (Reusable, nonsterile) Pedi-Check™ pediatric spot-check clip (Reusable, nonsterile)	D-YS D-YSE D-YSPD	>1 kg >30 kg 3 to 40 kg
Softcare™ nonadhesive sensor (Single-patient use, preterm infant)	SC-PR	<1.5 kg
Softcare™ nonadhesive sensor (Single-patient use, neonate)	SC-NEO	1.5 to 5 kg
Softcare™ nonadhesive sensor (Single-patient use, adult)	SC-A	>40 kg

The pulse oximetry cable DOC-10 connects the OxiMax N-600x pulse oximeter with the patient OxiMax pulse oximetry sensor.

OxiMax™ Pulse Oximetry Sensor Features

OxiMax pulse oximetry sensor features are different for sensors at a different revision level and by sensor type (adhesive, recycled, and reusable). The revision level of an OxiMax pulse oximetry sensor is located on the sensor plug.

Table 15. OxiMax Sensor Features

Feature	Adhesive Sensors	Recycled Sensors	Reusable Sensors	
	Revision B	Revision B	Revision A	Revision B
OxiMax Sensor Event Record	Yes	No	No	No
Sensor Messages	Yes	Yes	No	Yes
Sensor ID Message	Yes	Yes	Yes	Yes

Biocompatibility Testing

Biocompatibility testing has been conducted on OxiMax pulse oximetry sensors in compliance with ISO 10993-1, Biological Evaluation of Medical Devices, Part 1: Evaluation and Testing. The OxiMax pulse oximetry sensors have passed the recommended biocompatibility testing and are therefore in compliance with ISO 10993-1.

Optional Accessories

Overview

Several mounting configurations, a carrying case, and a utility basket are offered with the OxiMax N-600x pulse oximeter. Refer to the Nellcor website or contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative for information about these accessories.

http://www.nellcor.com/

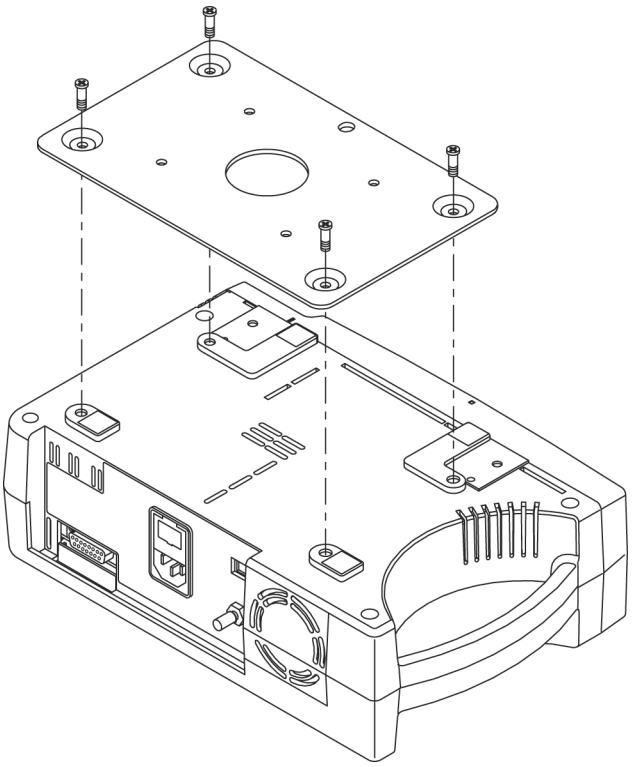
- GCX Adapter Plate. See page 97.
- GCX Wall Mount Arm and Channel. See page 98.
- GCX Roll Stand. See page 99.
- Soft-Sided Carrying Case. See page 100.

GCX Adapter Plate

Order an optional adapter plate from Nellcor. This adapter plate fits standard, commercially available GCX brackets, and securely mounts the oximeter to a wall bracket or a roll stand.

The adapter plate attaches to the bottom of the oximeter as shown. For further instructions regarding connecting the adapter plate to GCX brackets, refer to the illustrated *Directions for Use* included with the GCX adapter plate.

Figure 85. GCX Adapter Plate

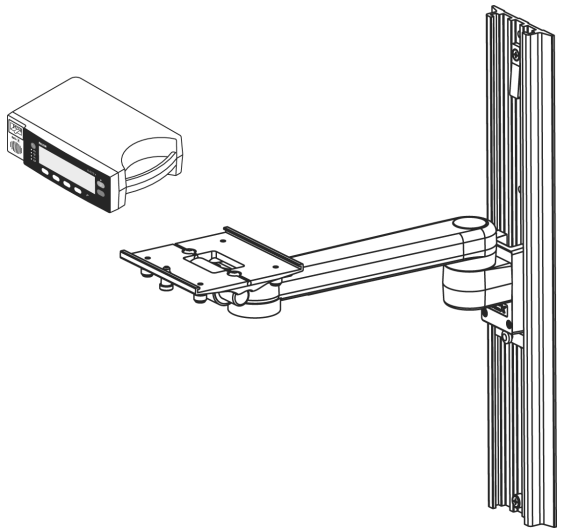


GCX Wall Mount Arm and Channel

Order this optional wall mount arm and 19-inch channel from Nellcor.

The M-Series wall mount arm attaches to the GCX adapter plate which attaches to the M-Series arm. The arm slides into the wall mount channel. For further details, refer to the illustrated *Directions for Use* included with the vertical wall mount arm.

Figure 86. GCX Wall Mount Arm and Channel

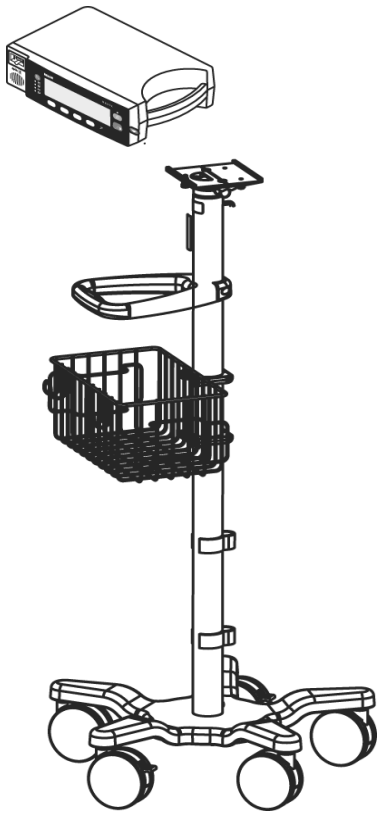


GCX Roll Stand

Order this optional GCX roll stand with utility basket and handle from Nellcor.

The GCX roll stand attaches to the oximeter GCX adapter plate as shown. For further instructions regarding connecting the GCX roll stand, refer to the illustrated *Directions for Use* included with the GCX roll stand.

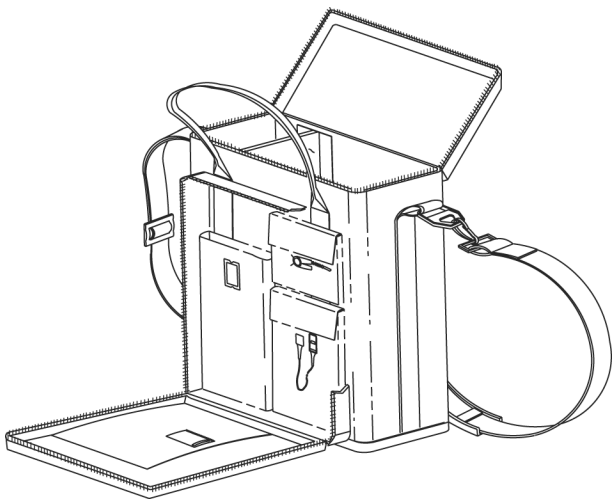
Figure 87. GCX Roll Stand



Soft-Sided Carrying Case

Order the optional soft-sided carrying case directly from Nellcor. The padded carrying case protects the oximeter during transport. The carrying case contains two pockets for OxiMax pulse oximetry sensors, cables, and *N-600x Operator's Manua*l.

Figure 88. Soft-Sided Carrying Case



7 Performance Considerations

Overview

WARNING

Pulse oximetry readings and pulse signals can be affected by certain ambient environmental conditions, OxiMax pulse oximetry sensor application errors, and certain patient conditions. See the appropriate sections of the manual for specific safety information.

- ***Safety Information*, page 7**
- ***Using OxiMax™ Pulse Oximetry Sensors and Accessories*, page 93**
- ***Performance Considerations*, page 101**

Verify the performance of the OxiMax N-600x™ pulse oximeter by following the procedures outlined in the *Modifying and Testing the Oximeter* section of the *N-600x Service Manual*. Have a qualified service technician perform these procedures prior to initial installation in a clinical setting.

Performance Considerations

Primary Considerations

Application issues and certain patient conditions can affect the measurements of the OxiMax N-600x pulse oximeter and cause the loss of the pulse signal.

Oximetry Application Issues

- Incorrect sensor application
- Failure to cover the sensor with opaque material in high ambient light conditions

Patient Conditions

- Dysfunctional hemoglobins
- Poor peripheral perfusion
- Excessive patient activity
- Venous pulsations
- Intravascular dyes, such as indocyanine green or methylene blue
- Dark pigment or externally applied coloring agents (nail polish, dye, pigmented cream)
- Defibrillation

Oximetry Considerations

Pulse Rates

The oximeter only displays pulse rates between 20 and 250 bpm. Detected pulse rates above 250 bpm are displayed as 250. Detected pulse rates below 20 are displayed as a zero (0).

Saturation

The oximeter displays saturation levels between 1% and 100%.

Patient Conditions

Dysfunctional Hemoglobins

Dysfunctional hemoglobins such as carboxyhemoglobin, methemoglobin, and sulphemoglobin are unable to carry oxygen. SpO_2 readings may appear normal; however, a patient may be hypoxic because less hemoglobin is available to carry oxygen. Further assessment beyond pulse oximetry is recommended.

Anemia

Anemia causes decreased arterial oxygen content. Although SpO_2 readings may appear normal, an anemic patient may be hypoxic. Correcting anemia can improve arterial oxygen content. The oximeter may fail to provide an SpO_2 reading if hemoglobin levels fall below 5 gm/dl.

OxiMax™ Pulse Oximetry Sensor Performance Considerations

Safety Information

WARNING
Pulse oximetry readings and pulse signal can be affected by certain ambient conditions, sensor application errors, and certain patient conditions.

WARNING
Tissue damage can be caused by incorrect application or inappropriate duration of use of an OxiMax pulse oximetry sensor. Inspect the sensor site as directed in the Directions for Use.

WARNING
Use only Nellcor-approved OxiMax pulse oximetry sensors and pulse oximetry cables when connecting to the OxiMax pulse oximetry sensor connector. Connecting any other cable or sensor influences the accuracy of sensor data, which may lead to adverse results.

WARNING
Failure to cover the OxiMax pulse oximetry sensor site with opaque material in high ambient light conditions may result in inaccurate measurements.

Inaccurate Sensor Measurement Conditions

A variety of conditions can cause inaccurate sensor measurements.

- Incorrect application of the OxiMax pulse oximetry sensor
- Placement of the OxiMax pulse oximetry sensor on an extremity with a blood pressure cuff, arterial catheter, or intravascular line
- Ambient light
- Excessive patient activity
- Dark pigment
- Intravascular dyes or externally applied coloring, such as nail polish or pigmented cream
- Failure to cover the OxiMax pulse oximetry sensor site with opaque material in high ambient light conditions

Signal Loss

Loss-of-pulse signal can occur for several reasons.

- The OxiMax pulse oximetry sensor is applied too tightly
- A blood pressure cuff is inflated on the same extremity as the attached OxiMax pulse oximetry sensor
- There is arterial occlusion proximal to the OxiMax pulse oximetry sensor
- Poor peripheral perfusion

Recommended Usage

Select an appropriate OxiMax pulse oximetry sensor, apply it as directed, and observe all warnings and cautions presented in the directions for use accompanying the sensor. Clean and remove any substances such as nail polish from the application site. Periodically check to ensure that the sensor remains properly positioned on the patient.

High ambient light sources such as surgical lights (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight can interfere with the performance of an OxiMax pulse oximetry sensor. To prevent interference from ambient light, ensure that the sensor is properly applied, and cover the sensor site with opaque material.

If patient activity presents a problem, try one or more of the following remedies to correct the problem.

- Verify the OxiMax pulse oximetry sensor is properly and securely applied.
- Move the sensor to a less active site.
- Use an adhesive sensor that improves patient skin contact.
- Use a new sensor with fresh adhesive backing.
- Keep the patient still, if possible.

If poor perfusion affects performance, consider using the Max-Fast™ adhesive forehead sensor, which provides vastly superior detection in the presence of vasoconstriction. Max-Fast pulse oximetry sensors work particularly well on supine

patients and mechanically ventilated patients. During low perfusion conditions, Max-Fast pulse oximetry sensors reflect changes to the SpO_2 up to 60 seconds earlier than digit sensors. If the Max-Fast pulse oximetry sensor is not available, consider using the OxiMax™ Max-R adhesive nasal sensor. It obtains extremely accurate measurements from a nasal artery supplied by the internal carotid that demonstrates less vasoconstriction than the peripheral vessels. This sensor may obtain measurements even when peripheral perfusion is relatively poor.

8 Troubleshooting

Overview

This section describes how to troubleshoot common problems while using your OxiMax N-600x™ pulse oximeter. This chapter includes information about the on-screen help function, error code messages, and how to obtain technical help and support.

WARNING
If you are uncertain about the accuracy of any measurement, check the patient's vital signs by alternate means; then make sure the pulse oximeter is functioning correctly.

WARNING
Only qualified service personnel should remove the oximeter cover. There are no user-serviceable parts inside.

WARNING
Do not spray, pour, or spill any liquid on the N-600x pulse oximeter, its accessories, connectors, switches, or openings in the chassis.

Help and Support

Technical Services

If you experience a problem while using the OxiMax N-600x pulse oximeter and are unable to correct it, contact Nellcor's Technical Services Department at 1.800.635.5267, or your local Nellcor representative. The *N-600x Service Manual*, used by qualified service personnel, provides additional troubleshooting information.

The *N-600x Service Manual* is available on the Internet at:

http://www.nellcor.com/serv/manuals.aspx/

On-Screen Help

The OxiMax N-600x pulse oximeter is equipped with an on-screen help system which enables you to browse and navigate through multiple help topics. Follow the steps outlined below to access and utilize the on-screen help.

To access on-screen help topics

Access multiple on-screen help topics and select a specific topic to view. Follow the example described below to access the SatSeconds help topic.

1. From the Main menu, press the HELP/CONTRAST key. The HELP MAIN window appears.

Figure 89. First Main Menu Help Screen

2. Press the ADJUST UP or ADJUST DOWN key to scroll through the available help topics or press NEXT to access page (2 / 2). Page (2 / 2) of the HELP MAIN window appears.

Figure 90. Second Main Menu Help Screen

3. From page (2 / 2) of the HELP MAIN window, press ADJUST DOWN to select SPD and then press SHOW. The HELP SPD window appears.The SPD help topic contains a total of ten (10) consecutive help windows. Press the NEXT softkey to scroll through each window of the selected help topic for the following information:

   "Saturation Pattern Detection detects repetitive patterns of desaturation in the SpO2 trend in adults. Caregivers are alerted to these patterns via a visual indicator, and optionally, an audio alarm. The triangle icon for Saturation Pattern Detection appears on the monitor display when the feature is enabled. The triangle fills from the bottom to the top as patterns become more severe and empties from top to bottom as the patterns become less severe. If the triangle fills, an alarm sounds. With Saturation Pattern Detection enabled, the default setting is On with the sensitivity set to 1. The feature can be turned off in the LIMITS menu. Caregivers can select from three alarm sensitivity settings: 1 (most sensitive), 2 (medium sensitivity) or 3 (least sensitive), with 1 resulting in more alarms and 3 resulting in fewer alarms.

   Enabling Saturation Pattern Detection automatically activates the SatSeconds feature.

   The TREND key blinks when a Saturation Pattern Detection alarm occurs. If the alarm is resolved, the TREND key stops blinking but remains highlighted until the caregiver presses it to view the event or clears it by pressing the TREND key."

4. From page (2 / 2) of the HELP MAIN window, press ADJUST DOWN to select PRDELAY and then press SHOW. The HELP PRDELAY window appears.The SatSeconds help topic contains a total of two (2) consecutive help windows. Press the NEXT softkey to scroll through each window of the selected help topic for the following information:

   "Pulse Rate Alarm Delay can reduce alarms reported for brief pulse rate limit violations. The Pulse Rate Alarm Delay can be set to 5 or 10 seconds, or OFF."

5. From page (2 / 2) of the HELP MAIN window, press ADJUST DOWN to select SATSECONDS and then press SHOW. The HELP SATSECONDS window appears. The SatSeconds help topic contains a total of six (6) consecutive help windows. Press the NEXT softkey to scroll through each window of the selected help topic for the following information.

   "SatSeconds can reduce alarms reported for mild or brief SpO2 limit violations. Each SpO2 violation can be described as a product of magnitude (number of percentage points of the SpO2 value falls outside the limit) and time (the number of seconds the SpO2 the value remains outside the limit). The SatSeconds limit sets the minimum value the SatSeconds must reach before an alarm is reported. For example: if the SpO2 lower alarm limit is 90 and the measured SpO2 value is 88, the resulting value is 2 after one second, 4 after two seconds, and so on. If the SatSeconds limit is set to 10, an alarm is reported after five seconds. To adjust the SatSeconds limit, press LIMITS."

6. Press the BACK softkey at any juncture to review the previous window(s). Continue to press BACK to return to the HELP MAIN window.

7. Press EXIT to return to the oximeter's Main menu.

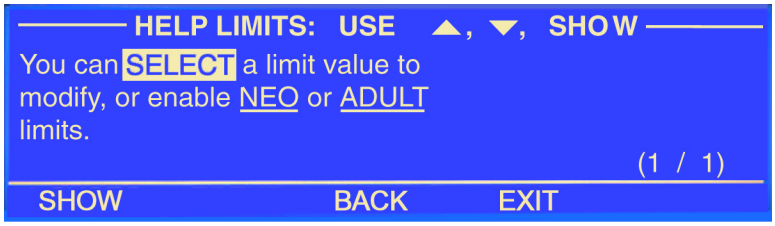
To access a single help topic

Access single on-screen help topics by pressing the HELP/CONTRAST key from a submenu. As an example, this procedure provides direction for accessing help information on the SatSeconds feature.

1. Press LIMITS on the oximeter Main menu and then SELECT to highlight SAT-S (SatSeconds).

2. Press the HELP/CONTRAST key. The HELP LIMITS window appears.

Figure 91. Limits Help Screen Main Menu



POX_10107_A

3. Press ADJUST UP or ADJUST DOWN to highlight an available help topic (SELECT, NEO and ADULT). For this example, highlight SELECT.

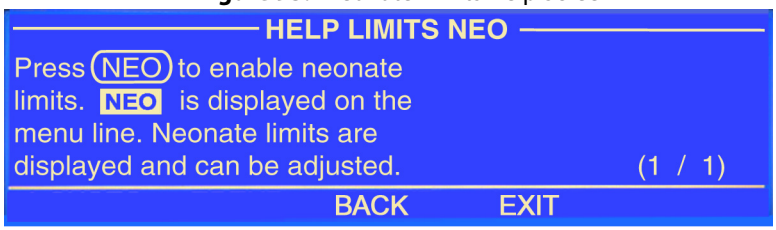
4. Press SHOW. The HELP LIMITS SELECT window appears.

Figure 92. Select Limits Help Screen

POX_10108_A

5. Press BACK.
6. Press ADJUST DOWN to highlight NEO and then press SHOW. The HELP LIMITS NEO window appears.

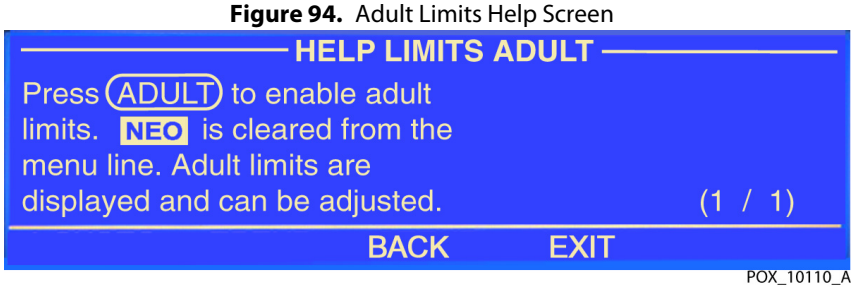
Figure 93. Neonate Limits Help Screen


HELP LIMITS NEO
Press NEO to enable neonate limits. NEO is displayed on the menu line. Neonate limits are displayed and can be adjusted.
(1 / 1)
BACK
EXIT

POX_10109_A

7. Press BACK.
8. Press ADJUST DOWN to highlight ADULT and the press SHOW. The HELP LIMITS ADULT window appears.

Figure 94. Adult Limits Help Screen


HELP LIMITS ADULT
Press ADULT to enable adult limits. NEO is cleared from the menu line. Adult limits are displayed and can be adjusted.
(1 / 1)
BACK
EXIT

POX_10110_A

9. Press EXIT to return to the LIMITS display.

Error Codes

When the oximeter detects an error condition, it displays “EEE” followed by an error code of up to three digits.

Figure 95. Error Condition Screen, Battery Failure

When an error code other than the ones listed in Table 17 on page 113 appears, turn the oximeter off and back on again. If the error code reappears, record it and notify service personnel. When this occurs, the unit will stop monitoring, remove all information from the screen and display the message “EEE XXX,” and sound a low priority alarm. Cycling the power clears these errors.

Prompts and Error Messages

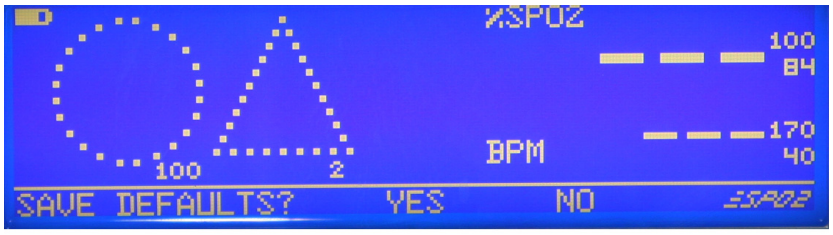
Occasionally, the menu area displays a prompt or error message. In most instances, messages remain displayed for a set time. This depends on the criticality of the message. High priority messages overwrite low priority messages. Messages of the same priority display in order of occurrence. For multiple messages, lower priority messages display when higher priority conditions clear. The highest priority is “1” and the lowest is “3.” Messages remain on the screen until the condition clears if the time-out setting is NONE. If the message has a maximum time to remain on the screen, it will have a time-out setting.

Note:

Pressing the ALARM and/or ALARM SILENCE key(s) clears some messages. Pressing the ALARM SILENCE key silences any audible tone and the second press clears the message.

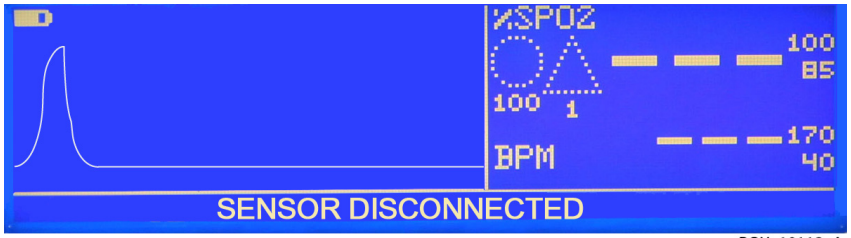
1. **Prompts**—Prompts require a response. For example, the SAVE DEFAULTS? prompt requires a user responsof YES or NO.

Figure 96. Save Defaults Prompt Screen



2. **Error messages**—Error messages provide information. The "Sensor Disconnected" error message leaves any action to the discretion of the user. Advisory messages appear as centered text at the bottom of the screen.

Figure 97. Sensor Disconnected Message Screen



POX 10112 A

Table 16. Common Prompts and Error Messages

Message	Time-out in seconds	Exit on Alarm	Exit on Alarm Silence	Displayed	Resolution
ADJUST CONTRAST UP/DOWN	10	Yes	Yes	When pressing and holding the HELP/CONTRAST key.	To adjust the contrast, use the ADJUST UP to increase the contrast or ADJUST DOWN key to decrease contrast.
CLOCK SETTING LOST	None	No	No	If the N-600x detects that the real-time clock has stopped running and both battery and AC power are lost.	Power-cycle the oximeter. If the error remains, recharge or replace the battery.
DATA IN SENSOR	5	No	Yes	When a sensor containing data is connected to the oximeter.	Clears on time-out, sensor disconnect, or pressing the ALARM SILENCE key, whichever comes first.
DATA TYPE SpO2+BPM	5	No	Yes	When a blank event sensor is connected to a oximeter with event data type set to SpO2+BPM.	Clears on time-out, sensor disconnect, or pressing the ALARM SILENCE key, whichever comes first.
DATA TYPE: SpO2	5	No	Yes	When a blank event sensor is connected to a oximeter with the event data type set to SpO2.	Clears on time-out, sensor disconnect, or pressing the ALARM SILENCE key, whichever comes first.

Table 16. Common Prompts and Error Messages

Message	Time-out in seconds	Exit on Alarm	Exit on Alarm Silence	Displayed	Resolution
DEFAULTS LOST	None	No	No	If the oximeter detects that power-on settings have been lost.	Leave the factory default settings, have a qualified service technician change institutional defaults, or change temporary limit settings.
DELETE TRENDS?	10	Yes	Yes	When attempting to delete trend data from memory by pressing the DELETE softkey.	Respond to the prompt, electing to delete trends by selecting YES or to retain by selecting NO.
HELP SPEAKER FAILURE	None	No	No	After pressing the HELP softkey provided after a Primary Speaker Failure.	Notify a qualified service technician. Once the oximeter powers down, it will not power on again until the technician replaces the failing speaker.
INVALID SILENCE DURATION	3	No	No	When attempting to save current settings as power-on defaults, even though the ALARM SILENCE duration is OFF.	If attempting to save defaults, turn ALARM SILENCE duration to a value, rather than OFF.
INVALID %SpO2 LIMIT	3	No	Yes	After attempting to set the default %SpO2 lower alarm limit below 85.	Set power-on %SpO2 lower alarm limit default at or above 85.
LOW BATTERY	None	No	Yes	When the oximeter is on battery power and the battery charge is low.	Connect to AC power to fully charge or temporarily acknowledge by pressing the ALARM SILENCE key.
PRIMARY SPEAKER FAILURE	None	No	No	Fatal error caused by a hardware failure. Once this error displays, the only option available is to press the HELP softkey, which produces the HELP SPEAKER FAILURE message.	Press the HELP softkey to review the HELP SPEAKER FAILURE message. Notify a qualified service technician. Once the oximeter powers down, it will not power on again until the technician replaces the failing speaker.

Table 16. Common Prompts and Error Messages

Message	Time-out in seconds	Exit on Alarm	Exit on Alarm Silence	Displayed	Resolution
READING TRENDS ...	None	Yes	Yes	When the oximeter needs more than four to six seconds to retrieve trend data from memory.	Completely retrieve sensor data or select ABORT.
REPLACE SENSOR	None	No	Yes	When the sensor or cable wiring is defective.	Temporarily acknowledge by pressing the ALARM SILENCE key. Replace sensor.
RESET DEFAULTS?	10	No	Yes	When attempting to reset oximeter to factory default setting by pressing the RESET softkey on the PARAMS menu.	Leave default settings as they are by selecting NO, or revert back to the original factory default settings by selecting YES.
SAVE DEFAULTS?	10	No	Yes	When attempting to save current settings as power-on defaults by pressing SAVE in the PARAMS menu.	Confirm the new institutional default settings by selecting YES, or leave default settings as they are by selecting NO.
SENSOR DISCONNECTED	None	No	Yes	When the sensor is disconnected from the pulse oximetry cable, the cable is not connected to the oximeter, or the cable wiring is defective.	Temporarily acknowledge by pressing the ALARM SILENCE key. Connect the cable and sensor or the oximeter, reconnect the sensor, or check all connections. If this does not clear the condition, replace the cable and/or sensor.
SENSOR TYPE	5	No	No	First message displayed when a sensor is connected to the oximeter.	Automatically clears on time-out.

Table 17. EEE Error Codes

Error Code	Error Message	Corrective Action
80	DEFAULTS LOST	The current power-on default settings have been lost and returned to factory defaults. Qualified service personnel can use the *N-600x Service Manual* to restore the desired power-on default settings.
81	SETTINGS LOST	The current settings (for example, alarm limits, alarm and pulse beep volumes, alarm silence duration) have been lost and returned to power-on defaults. Turn the oximeter off and back on again. If it is necessary to have settings different from the power-on default settings, turn the oximeter off and back on again, and reenter the desired settings.
82	CLOCK SETTING LOST	Date and time settings are lost. Reenter the date and time. Recharge or replace the battery.
515, 518, 534, 535, 569	N-600x Boot Version x.x.x.x	The application software is missing or corrupt. Notify a qualified service technician.
529, 729	LOW BATTERY	The battery is discharged to a critically low level. The oximeter will shutdown after 10 seconds. Verify the SUPPLY VOLTAGE SELECTOR switch on the rear panel is set to the proper voltage. Connect the oximeter to AC power and turn back on. A warning message is displayed and a low priority audible alarm sounded. Press the ALARM SILENCE key twice before the oximeter can be used for patient monitoring.
575	TRENDS LOST	Oximeter trends are corrupt and will be cleared. Turn off the oximeter, and then back on again.
701-716, 720-724, 732-740, 576-582	POWER SUPPLY FAILURE	The oximeter power supply has detected an error. The oximeter will shutdown after 10 seconds. Verify the oximeter is operating within specified environmental conditions. Notify a qualified service technician.
717, 718	BATTERY FAILURE	The oximeter has detected a battery open or short condition. The oximeter will shutdown after 10 seconds. Battery should be replaced. Notify a qualified service technician.
725-728, 730	REPLACE BATTERY	The battery is not charging properly. The oximeter will shutdown after 10 seconds. Battery should be replaced. Notify a qualified service technician.

Primary Speaker Failure

WARNING

If an OxiMax N-600x pulse oximeter reports a primary speaker failure, do not use the oximeter longer than necessary to ensure patient safety. Contact a qualified service technician, your local Nellcor representative, or Nellcor's Technical Services Department at 1.800.635.5267 for assistance.

Note:
Once the oximeter is silenced, the oximeter sounds a piezo tone every three minutes as a reminder of the primary speaker failure condition. The oximeter also sounds the piezo tone to annunciate low, medium and high priority alarms during this time. Once an oximeter reporting a primary speaker failure is powered off, it cannot be powered on again until repaired.

To access primary speaker failure messages

The oximeter may detect a failure of the primary speaker and sound a high-pitched, slow-pulsing piezo tone. A primary speaker failure message displays.

Figure 98. Primary Speaker Failure Screen

POX_10081_A

1. Press HELP to continue. The following message displays.

Figure 99. Speaker Failure Help Screen

POX_10080_A

2. Press BACK to display the speaker failure message again. The message cannot be cleared.
3. Press the ALARM SILENCE key to silence the slow-pulsing piezo tone.

Low and Critical Battery Conditions

Table 18. Low and Critical Battery Conditions

State	Critical Battery	Low Battery	AC Power	Operation
1	No	No	Yes	SpO2-normal AC/Battery charge LED-on LOW BATTERY LED-off LOW BATTERY message-off Audible alarm-off Error code-none Effect of ALARM SILENCE key-normal Shutdown-N/A
2	No	No	No	SpO2-normal AC/Battery charge LED-off LOW BATTERY LED-off LOW BATTERY message-off Audible alarm-off Error code-none Effect of ALARM SILENCE key-normal Shutdown- N/A
3	No	Yes	No	SpO2-normal AC/Battery charge LED-off LOW BATTERY LED-on LOW BATTERY message-on Audible alarm-low priority Error code-logged Effect of ALARM SILENCE key-First press silences audio alarm, second press cancels LOW BATTERY message (LED) stays on until Low Battery Condition is corrected. Shutdown-Imminent
4	No	Yes	Yes	SpO2-normal AC/Battery charge LED-on LOW BATTERY LED-on LOW BATTERY message-off Audible alarm-off Error code-logged Effect of ALARM SILENCE key-N/A (LED stays on) Shutdown-N/A
5	Not used			

Table 18. Low and Critical Battery Conditions

State	Critical Battery	Low Battery	AC Power	Operation
6	Yes	Yes	No	SpO2-not displayed AC/Battery charge LED-off LOW BATTERY LED-on (flashing) LOW BATTERY message-on Audible alarm-high priority Error code-displayed and logged Effect of ALARM SILENCE key-none Shutdown-after 10 seconds
7	Yes	Yes	Yes	SpO2 - displayed. AC/Battery Charge LED - on LOW BATTERY LED-on (flashing) LOW BATTERY message - on The Battery Fuel Gauge shows a fully depleted battery (no bars lit). Warning message in the pleth window: UNIT WILL SHUT DOWN IF AC POWER LOST Audio alarm - low priority Error code - logged Effect of ALARM SILENCE key - One press silences the audible alarm. Pressing the ALARM SILENCE key twice cancels the LOW BATTERY message, removes the warning message and restores default display (LED continues to FLASH until Low Battery condition is not true, Battery Fuel Gauge shows charging progress) Shutdown - N/A

Table 19. Common Problems and Resolutions

Problem	Resolution
There is no response when I press the ON/STANDBY key.	Ensure the supply voltage selector switch is set to the proper voltage. A fuse may be malfunctioning. Notify a qualified service technician to check and, if necessary, replace the fuse. If operating on battery power, the battery may be missing or discharged. If the battery is discharged, charge the battery, see *Monitoring Oximeter Power*, page 33. If the battery does not charge, notify a service personnel to replace the battery.
One or more display elements or indicators do not light during the power-on self-test (POST).	Do not use the N-600x pulse oximeter; contact qualified service personnel or your local Nellcor representative.
The oximeter is operating on battery power, even though it is connected to an AC power source.	Ensure the supply voltage selector switch is set to the proper voltage. Ensure the power cord is properly connected to the oximeter. Check to see if power is available to other equipment on the same AC circuit.

Table 19. Common Problems and Resolutions

Problem	Resolution
The Pulse Search Indicator is lit for more than 10 seconds (before any measurements are taken).	Check the OxiMax™ pulse oximetry sensor *Directions for Use* to confirm appropriate usage and proper application. Check sensor and pulse oximetry cable connections. Test the OxiMax pulse oximetry sensor on another patient and/or try another OxiMax pulse oximetry sensor or pulse oximetry cable. Perfusion may be too low for the oximeter to track the pulse. Check the patient. Test the oximeter on someone else. Change the OxiMax pulse oximetry sensor site. Try another type of OxiMax pulse oximetry sensor. Interference may be preventing the oximeter from tracking the pulse. Keep the patient still, if possible. Verify that the sensor is securely applied and replace it if necessary. Change the sensor site. Electromagnetic interference may be preventing the oximeter from tracking the pulse. Remove the source of interference and/or try to stabilize the environment. Use a type of OxiMax pulse oximetry sensor that tolerates more patient movement; for example, an OxiMax adhesive sensor. The OxiMax pulse oximetry sensor may be too tight, there may be excessive ambient light, or the sensor may be on an extremity with a blood pressure cuff, arterial catheter, or intravascular line. Reposition the sensor as necessary.
The Pulse Search Indicator illuminates after successful measurements have been made.	Check the status of your patient. Perfusion may be too low for the oximeter to track the pulse. Test the oximeter on another patient. Change the OxiMax pulse oximetry sensor site and/or try another type of OxiMax pulse oximetry sensor. Interference may be preventing the oximeter from tracking the pulse. Verify the OxiMax pulse oximetry sensor is securely applied and replace it if necessary. Change the sensor site. Use a type of OxiMax pulse oximetry sensor that tolerates more patient movement; for example, an OxiMax adhesive sensor. Electromagnetic interference may be preventing the oximeter from tracking the pulse. Remove the source of interference and/or try to stabilize the environment. The OxiMax pulse oximetry sensor may be too tight, there may be excessive ambient light, or the sensor may be on an extremity with a blood pressure cuff, arterial catheter, or intravascular line. Reposition the sensor as necessary.
Error Code: “EEE XXX” followed by a number appears.	Press the ON/STANDBY key and allow the oximeter to shut off completely. Then press the key again to turn back on the oximeter. If the error code persists, record the number and provide this information to a qualified service technician, or your local Nellcor representative. Error Code “EEE 529 or 729" displays when the battery discharges to a critically low level. Ensure the SUPPLY VOLTAGE SELECTOR switch on the rear panel is set to the proper voltage based on your location. Press the ON/STANDBY key and allow the oximeter to shut off completely. Allow the battery to charge for about ten minutes and then turn back on the unit back. If the error code is still present, turn the unit off and allow it to continue to charge. If the oximeter has been charged for 30 minutes and the error code persists, contact Nellcor’s Technical Services Department at 1.800.635.5267 or your local Nellcor representative.

Obtaining Technical Assistance

For technical information and assistance, to order parts, or to order an *N-600x Service Manual*, contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative. The *N-600x Service Manual* includes block diagrams, schematics, and a parts list required by qualified personnel when servicing the oximeter.

When calling Nellcor's Technical Services Department, or your local Nellcor representative, have the oximeter serial number, as well as the firmware version number of your oximeter.

The software version appears in the oximeter display each time the oximeter successfully completes the power-on self-test. Write the number down and have it available whenever requesting technical assistance.

Returning your Oximeter

Contact Nellcor's Technical Services Department at 1.800.635.5267 or your local Nellcor representative for shipping instructions, including a Returned Goods Authorization (RGA) number. Unless otherwise instructed by Nellcor's Technical Services Department, it is not necessary to return the sensor or other accessory items with the oximeter. Pack the oximeter in its original shipping carton. If the original carton is not available, use a suitable carton with the appropriate packing material to protect it during shipping.

Return the oximeter by any shipping method that provides proof of delivery.

9 Oximeter Maintenance

Overview

This section describes the steps required to maintain, service, and properly clean your OxiMax N-600x™ pulse oximeter. Follow local governing ordinance and recycling instructions regarding the disposal or recycling of the oximeter and its accessories.

Cleaning

WARNING

Do not spray, pour, or spill any liquid on the OxiMax N-600x pulse oximeter, its accessories, connectors, switches, or openings in the chassis.

For surface cleaning and disinfection of the oximeter, follow your institution's procedures or the recommended actions below.

- **Surface cleaning**—Use a soft cloth dampened with either a commercial, nonabrasive cleaner or a solution of 70% alcohol in water, lightly wiping the surfaces of the oximeter.
- **Disinfection**—Use a soft cloth saturated with a solution of 10% chlorine bleach in tap water, lightly wiping the surface of the oximeter.

Before attempting to clean an OxiMax™ pulse oximetry sensor, read the *Directions for Use* enclosed with the sensor. Each sensor model has cleaning instructions specific to that sensor. Follow the OxiMax pulse oximetry sensor cleaning and disinfecting procedures in the particular sensor's *Directions for Use*.

Periodic Safety Checks

Perform the following checks every 24 months.

- Inspect the equipment for mechanical and functional damage or deterioration.
- Inspect the safety relevant labels for legibility. Contact Nellcor Technical Services, 1.800.635.5267, or your local representative, if labels are damaged or illegible.
- Inspect the internal fuse (F3) for proper value and rating.
- Ensure all user interface keys, cables, and accessories function normally.

Service

WARNING

Only qualified service personnel should remove the oximeter cover. There are no user-serviceable parts inside.

- The OxiMax N-600x pulse oximeter requires no calibration.
- Have a qualified service technician replace the battery at least every 24 months.
- If service is necessary, contact Nellcor's Technical Services Department at 1.800.635.5267, a qualified service technician, or your local Nellcor representative. Refer to *Obtaining Technical Assistance*, page 118.

10 Theory of Operations

Overview

This section explains the theory behind OxiMax N-600x™ pulse oximeter operations.

Understanding Pulse Oximetry

Theoretical Principles

The OxiMax N-600x pulse oximeter uses pulse oximetry to measure functional oxygen saturation in the blood. Pulse oximetry works by applying an OxiMax™ pulse oximetry sensor to a pulsating arteriolar vascular bed, such as a finger or toe. The sensor contains a dual light source and a photodetector.

Bone, tissue, pigmentation, and venous vessels normally absorb a constant amount of light over time. The arteriolar bed normally pulsates and absorbs variable amounts of light during the pulsations. The ratio of light absorbed is translated into a measurement of functional oxygen saturation (SpO_2).

Ambient conditions, sensor application, and patient conditions can influence the ability of the oximeter to accurately measure SpO_2. Reference *Performance Considerations*, page 101.

Pulse oximetry is based on two principles: oxyhemoglobin and deoxyhemoglobin differ in their absorption of red and infrared light (measured using spectrophotometry), and the volume of arterial blood in tissue (and hence, light absorption by that blood) changes during the pulse (registered using plethysmography). A pulse oximeter determines SpO_2 by passing red and infrared light into an arteriolar bed and measuring changes in light absorption during the pulsatile cycle. Red and infrared low-voltage light-emitting diodes (LED) in the sensor serve as light sources; a photo diode serves as the photo detector.

Since oxyhemoglobin and deoxyhemoglobin differ in light absorption, the amount of red and infrared light absorbed by blood is related to hemoglobin oxygen saturation.

The oximeter uses the pulsatile nature of arterial flow to identify the oxygen saturation of arterial hemoglobin. During systole, a new pulse of arterial blood enters the vascular bed, and blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The pulse oximeter bases its SpO_2 measurements on the difference between maximum and minimum absorption (measurements at systole and diastole). By doing so, it focuses on light

absorption by pulsatile arterial blood, eliminating the effects of nonpulsatile absorbers such as tissue, bone, and venous blood.

Automatic Calibration

Because light absorption by hemoglobin is wavelength dependent and because the mean wavelength of LEDs varies, an oximeter must know the mean wavelength of the OxiMax pulse oximetry sensor's red LED to accurately measure SpO_2.

During monitoring, the oximeter's software selects coefficients that are appropriate for the wavelength of that individual sensor's red LED; these coefficients are then used to determine SpO_2.

Additionally, to compensate for differences in tissue thickness, the light intensity of the sensor's LEDs is adjusted automatically.

Note:

During certain automatic calibration functions, the OxiMax N-600x pulse oximeter may briefly display a flat line on the plethysmographic waveform. This is a normal operation and does not require any user intervention.

Functional versus Fractional Saturation

This pulse oximeter measures functional saturation where oxygenated hemoglobin is expressed as a percentage of the hemoglobin that can transport oxygen. It does not detect significant amounts of dysfunctional hemoglobin, such as carboxyhemoglobin or methemoglobin. In contrast, hemoximeters such as the IL482 report fractional saturation where oxygenated hemoglobin is expressed as a percentage of all measured hemoglobin, including measured dysfunctional hemoglobins. To compare functional saturation measurements to those from an oximeter that measures fractional saturation, fractional measurements must be converted using the listed equation.

Figure 100. Fractional Saturation Conversion Equation

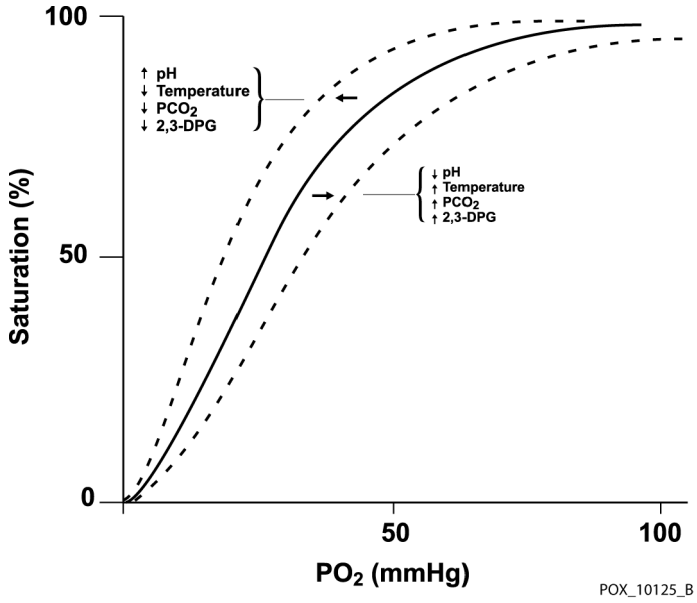
$$\text{functional saturation} = \frac{\text{fractional saturation}}{100 - (\%\text{carboxyhemoglobin} + \%\text{methemoglobin})} \times 100$$

Measured versus Calculated Saturation

When calculating saturation from a blood gas partial pressure of oxygen (PO_2), the calculated value may differ from the SpO_2 measurement of a pulse oximeter. This usually occurs when saturation calculations exclude corrections for the effects of

variables such as pH, temperature, the partial pressure of carbon dioxide (PCO_2), and 2,3-DPG, that shift the relationship between PO_2 and SpO_2.

Figure 101. Oxyhemoglobin Dissociation Curve



Oximeter Features

SatSeconds™ Alarm Management Feature

The oximeter monitors hemoglobin saturation with oxygen in the blood. With traditional alarm management, upper and lower alarm limits are set for monitoring SpO_2 levels. When the SpO_2 fluctuates near an alarm limit, the alarm sounds each time it violates an alarm limit. SatSeconds monitors both degree and duration of desaturation as an index of desaturation severity. Thus, the SatSeconds feature distinguishes clinically significant events from minor and brief SpO_2 limit violations that result in nuisance alarms.

Set upper and lower alarm limits using traditional alarm management methods. Then, use SatSeconds alarm management to defer the audible alarm for the specified period, even if the SpO_2 is below the selected lower alarm limit. Refer to *Using the SatSeconds™ Alarm Management Feature*, page 64, for managing SatSeconds alarms.

Pulse Rate Delay Alarm Management Feature

The oximeter also monitors pulse rate by determining the number of pleth waves over unit time. With traditional alarm management, upper and lower alarm limits are set for monitoring pulse rate. When the pulse rate fluctuates near an alarm limit, the alarm sounds each time it violates an alarm limit. The Pulse Rate Delay feature allows a period of threshold violation before the pulse rate alarm sounds. Thus, the Pulse

Rate Delay feature distinguishes clinically significant events from minor and brief pulse rate limit violations that result in nuisance alarms.

To use the Pulse Rate Delay feature, set the traditional alarm management upper and lower pulse rate alarm limits. Then, set the Pulse Rate Delay. The Pulse Rate Delay limit controls the time the pulse rate level crosses either limit before an audible alarm sounds. Refer to *Using the Pulse Rate Delay Alarm Management Feature*, page 63, for managing pulse rate alarms.

OxiMax SPD™ Alert Feature

The OxiMax SPD™ Alert (SPD) method of detecting patterns of desaturation in adults is a function of the software within the OxiMax N-600x pulse oximeter, which detects repetitive occurrences of desaturation followed by resaturation. These patterns are indicative of repetitive reductions in airflow through the upper airway and into the lungs. When SPD is enabled, the default value for SatSeconds is set to100. Set the upper and lower SpO_2 alarm limits using traditional alarm management methods. Set the alarm type to visual only or audio and visual. The default setting of one (1) is the most sensitive to patterns of desaturation. Select from three alarm sensitivity settings: 1 (most sensitive), 2 (medium sensitivity) or 3 (least sensitive), with 1 resulting in more alarms and 3 resulting in fewer alarms, or turn it to OFF. The alarm sensitivity value appears directly under the SPD triangle icon. Refer to *Using the OxiMax SPD™ Alert Feature*, page 60, for detecting patterns of desaturation.

OxiMax™ Pulse Oximetry Sensor Technology

Use OxiMax™ pulse oximetry sensors, which are specifically designed for use with the oximeter. Identify OxiMax pulse oximetry sensors by the deep blue and/or white colors of the plugs. All OxiMax pulse oximetry sensors contain a memory chip carrying information about the sensor which the oximeter needs for correct operation, including the sensor's calibration data, model type, troubleshooting codes, and error detection data.

This unique oximetry architecture enables several new features. When an OxiMax pulse oximetry sensor is connected to the OxiMax N-600x pulse oximeter, the oximeter reads the information from the OxiMax pulse oximetry sensor memory chip, ensures it is error free, and then loads the sensor data prior to monitoring for new information. As the oximeter reads sensor information, it flashes the sensor model number on its display. This process may take a few seconds. Once the reading process is complete, the sensor model number stops flashing and monitoring begins. The sensor model number disappears after the pulse oximeter starts tracking the patient's SpO_2 and pulse rate.

Pulse oximeters containing OxiMax technology, including the OxiMax N-600x pulse oximeter, use calibration data contained in the OxiMax pulse oximetry sensor in calculating the patient's SpO_2. With sensor calibration, the accuracy of many sensors is improved, since the calibration coefficients can be tailored to each OxiMax pulse oximetry sensor. Consult the accuracy card included with the oximeter for specific

accuracy information for the oximeter with different Nellcor approved OxiMax pulse oximetry sensors.

The OxiMax N-600x pulse oximeter uses the information in the OxiMax pulse oximetry sensor, tailoring messages to better help the clinician troubleshoot client or data issues. The sensor automatically identifies its sensor type to the oximeter when attached. The oximeter determines the sensor type and recommended patient site for each model.

Functional Testers and Patient Simulators

Some models of commercially available bench top functional testers and patient simulators can be used to verify the proper functionality of OxiMax pulse oximetry sensors, cables and oximeters. See the individual testing device's operator's manual for the procedures specific to the model of tester being used.

While such devices may be useful for verifying that the pulse oximeter sensor, cabling, and oximeter are functional, they are incapable of providing the data required to properly evaluate the accuracy of a system's SpO_2 measurements. Fully evaluating the accuracy of the SpO_2 measurements requires, at a minimum, accommodating the wavelength characteristics of the sensor and reproducing the complex optical interaction of the sensor and the patient’s tissue. These capabilities are beyond the scope of known bench top testers. SpO_2 measurement accuracy can only be evaluated in vivo by comparing pulse oximeter readings with SaO_2 measurements obtained from simultaneously sampled arterial blood made using a laboratory CO-oximeter.

Many functional testers and patient simulators have been designed to interface with the pulse oximeter's expected calibration curves and may be suitable for use with Nellcor oximeters and/or sensors. Not all such devices, however, are adapted for use with the Nellcor OxiMax digital calibration system. While this will not affect use of the simulator for verifying system functionality, displayed SpO_2 measurement values may differ from the setting of the test device. For a properly functioning oximeter, this difference will be reproducible over time and from oximeter to oximeter within the performance specifications of the test device.

11 Product Specifications

Overview

This section contains OxiMax N-600x™ pulse oximeter physical and operational specifications. Ensure all product requirements are met prior to installation of the oximeter.

Physical Characteristics

Weight	5.8 lbs. (2.6 kg)
Dimensions	3.3 in. x 10.4 in. x 6.8 in. (8.4 cm x 26.4 cm x 17.3 cm)

Electrical Requirements

Power

Power Requirements	Rated at 100 to 120 volts AC (nominal 120 VAC) or 220 to 240 volts AC (nominal 230 VAC), 30 VA
Input Frequency	50/60 Hz
Fuses	Slow-blow 0.5 amp, 250 volts, IEC (5 x 20 mm) Quantity: 2 external

Battery

Note:

The battery provides approximately seven hours of battery life when new and fully-charged with no alarms, no serial data, no analog output, no nurse call output, with backlight on while using a pulse simulator set for 200 bpm, high light and low modulation.

Type	Lead acid
Voltage	6 Volts DC
Recharge	8 hours with oximeter turned off 12 hours with oximeter turned on
Shelf Life	Four months, if oximeter runs on new, fully-charged battery After four months storage, units run 33% of stated battery life
Compliance	91/157/EEC

Rating of Nurse Call Relay

Maximum Input Voltage	30 VAC or VDC (polarity is not important)
Load Current	120 mA continuous (peak 300 mA @ 100 ms)
Minimum Resistance	26.5 ohms to 50.5 ohms (40.5 ohms typical) during alarms
Ground Reference	Isolated Ground
Electrical Isolation	1500 Volts

Environmental Conditions

Operating

Temperature	5 ºC to 40 ºC (41 ºF to 104 ºF)
Altitude	-390 m to 3,012 m (-1,254 ft. to 9,882 ft.)
Atmospheric Pressure	70 kPa to 106 kPa (20.6 in. Hg to 31.3 in. Hg)
Relative Humidity	15% to 95% non-condensing

Transport and Storage

	Not in shipping container	**In shipping container**
Temperature	-20 ºC to 60 ºC (-4 ºF to 140 ºF)	-20 ºC to 70 ºC (-4 ºF to 158 ºF)
Altitude	-390 m to 5,574 m (-1,254 ft. to 18,288 ft.)	-390 m to 5,574 m (-1,254 ft. to 18,288 ft.)
Atmospheric Pressure	50 kPa to 106 kPa (14.7 in. Hg to 31.3 in. Hg)	50 kPa to 106 kPa (14.7 in. Hg to 31.3 in. Hg)
Relative Humidity	15% to 95% non-condensing	15% to 95% non-condensing

Performance Specifications

Measurement Range

SpO2 Saturation Range	1% to 100%
Pulse Rate Range	20 to 250 beats per minute (bpm)
Perfusion Range	0.03% to 20%

OxiMax™ Pulse Oximetry Sensors

Pulse Oximetry Sensor Accuracy

Table 20. Oxygen Saturation Accuracy[1]

Sensor Model Type	LoSAT™ Range 60% to 80%	Standard Saturation Range 70% to 100%
MAX-A, MAX-AL	± 3.0 digits	± 2.0 digits
MAX-N[2] (Adult and Neonate)	± 3.0 digits	± 2.0 digits
MAX-P, MAX-I, MAX-FAST	± 3.0 digits	± 2.0 digits
Softcare™ SC-A, -PR, -NEO[3]	N/A	± 2.0 digits
MAX-R	N/A	± 3.5 digits
Low Perfusion[4]	N/A	± 2.0 digits
Pulse Rate		
Normal Range	20 to 250 bpm	± 3.0 digits
Low Perfusion[4]	20 to 250 bpm	± 3.0 digits

[1] Subjects used to validate SpO2 measurement accuracies were healthy and recruited from the local population. Comprised of both men and women, subjects spanned a range of skin pigmentations and ranged in age from 18-50 years old. Accuracy specifications are based on controlled hypoxia studies with healthy non-smoking adult volunteers over the specified saturation SpO2 range(s). Pulse oximeter SpO2 readings were compared to SaO2 values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ±1 SD. Pulse oximeter equipment measurements are statistically distributed; about two-thirds of pulse oximeter measurements can be expected to fall in this accuracy (ARMS) range. Because scatter and bias of pulse oximeter SpO2 and blood SaO2 comparison commonly increase as the saturation decreases, and accuracy specifications are calculated from data spanning the stated range, different accuracy values may result when describing partially overlapping ranges.

[2] Clinical functionality of the MAX-N has been demonstrated on a population of hospitalized neonate patients. The observed SpO2 accuracy was 2.5% in a study of 42 patients with ages of 1 to 23 days, weight from 750 to 4,100 grams, and 63 observations made spanning a range of 85% to 99% SaO2.

[3] Clinical functionality has been demonstrated in a population of hospitalized neonate patients. The observed SpO2 accuracy was 3.0% in a study of 57 patients with ages of 24 to 40 weeks, weight from 710 to 5,000 grams, and 185 observations made spanning a range of 63% to 99% SaO2.

[4] Specification applies to N-600x oximeter performance. Reading accuracy in the presence of low perfusion (detected IR pulse modulation amplitude 0.03% - 1.5%) was validated using signals supplied by a patient simulator. SpO2 and pulse rate values were varied across the monitoring range over a range of weak signal conditions and compared to the known true saturation and pulse rate of the input signals.

Note:

For a complete listing of SpO2 accuracy across the full line of available OxiMax™ pulse oximetry sensors, contact 1.800.635.5267.

Sensor Power Dissipation

Pulse Oximetry Sensor	Dissipation
OxiMax MAX-A, -AL, -I, -N, -P, -R	52.5 mW
OxiMax Durasensor™ DS-100A	52.5 mW
OxiMax OxiCliq™ A, I, N, P	52.5 mW
OxiMax Dura-Y™ D-YS	52.5 mW
OxiMax Max-Fast™	52.5 mW
OxiMax Softcare™ SC-A, -NEO, -PR	52.5 mW

OxiMax Pulse Oximetry Sensor Operating Range

Red Light Wavelength	Approximately 660 nm
Infrared Light Wavelength	Approximately 900 nm
Optical Output Power	Less than 15 mW

Product Compliance

Product Standards for Compliance

ISO 9919:2005
EN ISO 9919: 2005

Product Safety Standards

IEC 60601-1: 1988 + A1: 1991 + A2: 1995
EN 60601-1: 1990 + A11: 1993 + A12: 1993 + A13: 1996
UL 60601-1 1st edition
CSA C22.2 No. 601.1 M90

Protection Type	Class I (Internally powered)
Mode of Operation	Continuous
Liquid Ingress	IPX1
Degree of Safety	Not suitable for use in the presence of a flammable anaesthetic gas

Electromagnetic Compatibility (EMC) Standards

IEC 60601-1-2: 2001 + A1: 2004
EN 60601-1-2: 2001 + A1: 2006

Manufacturer's Declaration

Basics

WARNING

The use of accessories, OxiMax sensors, and cables other than those specified may result in inaccurate readings of the OxiMax N-600x pulse oximeter and increased emission of the oximeter.

The OxiMax N-600x pulse oximeter is suitable for prescription use only in the specified electromagnetic environments. Use the unit in accordance with the electromagnetic environments described in this section.

Electromagnetic Compatibility (EMC)

Electromagnetic Emissions

Table 21. Electromagnetic Emissions

Emissions Test	Compliance	Electromagnetic Environment Guidance
RF emissions CISPR 11: 2004	Group 1 Class B	The oximeter is suitable for use in all establishments.
Harmonic emissions IEC 61000-3-2: 2005	Class A	The oximeter is suitable for use in all establishments.
Voltage fluctuations/ flicker emission IEC 61000-3-3: 2005	Complies	The oximeter is suitable for use in all establishments.

Electromagnetic Immunity

Note:

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Table 22. Electromagnetic Immunity Testing

Immunity Test	IEC 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
Electrostatic discharge (ESD) IEC 61000-4-2: 2001	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floor should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electric fast transient/burst IEC 61000-4-4: 1995 + A1: 2000 + A2: 2001	± 2 kV for power supply lines ± 1 kV for input/ output lines	± 2 kV for power supply lines ± 1 kV for input/ output lines	Mains power quality should be that of a typical commercial and/or hospital environment.
Surge IEC 61000-4-5: 2005	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial and/or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply IEC 61000-4-11: 2004	<5% UT (>95% dip in UT) for 0.5 cycle	<5% UT (>95% dip in UT) for 0.5 cycle	Mains power quality should be that of a typical commercial and/or hospital environment.. If the user of the oximeter requires continued operation during power mains interruption, it is recommended that the oximeter be powered from an uninterruptible power supply or battery. Note: UT is the AC main's voltage prior to application of the test level.
	40% UT (60% dip in UT) for five cycles	40% UT (60% dip in UT) for five cycles	
	70% UT (30% dip in UT) for 25 cycles	70% UT (30% dip in UT) for 25 cycles	
	<5% UT (95% dip in UT) for five seconds	<5% UT (95% dip in UT) for five seconds	
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8: 2001	3 A/m	3 A/m	If image distortion occurs, it may be necessary to position the oximeter further from the sources of power frequency magnetic fields or to install magnetic shielding. The power frequency magnetic field should be measured in the intended installation location to assure that it is sufficiently low.

Table 23. Recommended Separation Distances

Immunity Test	IEC 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
	Frequency of Transmitter		**Equation for Separation Distance**
Conducted RF IEC 61000-4-6: 2006	3 Vrms 150 kHz 80 MHz	3 Vrms	distance = 1.2
Radiated RF IEC 61000-4-3: 2006	3 V/m 80 MHz 800 MHz	3 V/m	distance = 1.2
	3 V/m 800 MHz 2.5 GHz	3 V/m	distance = 2.3
Rated Maximum Output Power of Transmitter in Watts	**Separation Distance in Meters**	**Separation Distance in Meters**	**Separation Distance in Meters**
0.01	0.12	0.12	0.23
0.10	0.38	0.38	0.73
1.00	1.20	1.20	2.30
10.00	3.80	3.80	7.30
100.00	12.00	12.00	23.00

For transmitters rated at a maximum output power not listed above, the separation distance can be estimated using the equation in the corresponding column, where P is the maximum output [power rating of the transmitter in watts (W)] according to the transmitter manufacturer.

Note:

Portable and mobile RF communications equipment should be used no closer to any part of the OxiMax N-600x pulse oximeter, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter.

Sensor and Cable Compliance

WARNING

The use of accessories, OxiMax sensors, and cables other than those specified may result in inaccurate readings of the OxiMax N-600x pulse oximeter and increased emission of the oximeter.

Table 24. Cables and Sensors

Item	Maximum Length
Cables	
Power cord	10.0 ft. (3 m)
DOC-10 pulse oximetry cable	10.0 ft. (3 m)
Software download cable, RS-232 serial, 15 to 9 pin "D"	10.0 ft. (3 m)
Non-terminated cable, RS-232 analog, 15 pin "D"	3.3 ft. (1 m)
Printer cable, RS-232, 15 to 9 pin "D"	10.0 ft. (3 m)
Philips interface cable	3.3 ft. (1 m)
Oxinet™ III hardwire cable	10.0 ft. (3 m)
Oxinet™ III data cable	10.0 ft. (3 m)
Sensors	
OxiMax sensors: MAX-A, MAX-I, MAX-N, MAX-P, MAX-R MAX-AL	 1.5 ft. (0.5 m) 3.0 ft. (0.9 m)
OxiMax Oxiband™ sensors: OXI-A/N, OXI-P/I	3.0 ft. (0.9 m)
OxiMax Durasensor™ DS-100A	3.0 ft. (0.9 m)
OxiMax OxiCliq™ sensors: P, N, I, A	OC-3 cable 3.0 ft. (0.9 m)
OxiMax Dura-Y™ sensors: D-YS, D-YSE, D-YSPD	4.0 ft. (1.2 m)

Safety Tests

Ground Integrity

100 milliohms or less

Leakage Current

The following tables display the maximum earth and enclosure leakage current allowed, as well as patient leakage.

Table 25. Earth and Enclosure Leakage Current Specifications

Earth Leakage Current					
Condition	**AC Polarity**	**Line Cord**	**Neutral Line Cord**	**IEC 60601-1**	**UL 60601-1**
Normal	Normal	Closed	Closed	500 µA	300 µA
Single Fault		Open	Closed	1000 µA	
		Closed	Open		
Normal	Reversed	Closed	Closed	500 µA	300 µA
Single Fault		Open	Closed	1000 µA	
		Closed	Open		
Enclosure Leakage Current					
Condition	**AC Line Polarity**	**Neutral Line Cord**	**Power Line Ground**	**IEC 60601-1 UL 60601-1**	
Normal	Normal	Closed	Closed	100 µA	
Single Fault		Open	Closed	500 µA	
		Closed	Open		
Normal	Reversed	Closed	Closed	100 µA	
Single Fault		Open	Closed	500 µA	
		Closed	Open		

Table 26. Patient Applied and Patient Isolation Risk Current

Patient Applied Risk Current				
Condition	**AC Line Polarity**	**Neutral Line**	**Power Line Ground Cable**	**IEC 60601-1 UL 60601-1**
Normal	Normal	Closed	Closed	100 µA
Single Fault		Open	Closed	500 µA
		Closed	Open	
Normal	Reversed	Closed	Closed	100 µA
Single Fault		Open	Closed	500 µA
		Closed	Open	
Patient Isolation Risk Current				
Condition	**AC Line Polarity**	**Neutral Line**	**Power Line Ground Cable**	**IEC 60601-1 UL 60601-1**
Single Fault	Normal	Closed	Closed	5000 µA
	Reversed	Closed	Closed	

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Rx ONLY

CE 0123

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